MILITARY

SIGNALS

LAND ★ SEA ★ AIR

THE DEPARTMENT OF DEFENSE SECRETARIES

SEPTEMBER-OCTOBER 1949

800,000 people own the Bell Telephone Business

One out of every 60 families in the United States shares in the ownership of the Bell System

There are 800,000 stockholders of the American Telephone and Telegraph Company. Their savings have helped provide the telephone system that serves you.

Most of them are small stockholders. 230,000 own five shares or less. The average holding is thirty shares. More than one-third have owned their shares for fifteen years or longer.

No one—no individual, company or institution—owns as much as one-third of one per cent of A. T. & T. stock.

The people who own the Bell System come from all walks of life throughout the cities, towns and countryside of America. One in every 60 families in the United States shares directly in this ownership.

Every time you use the telephone, the accumulated, small investments of these hundreds of thousands of people go to work for you.

They have built the best and most widespread system of communication in the world for you to use at low cost. It is from their savings, and the savings of many like them, that the money needed to improve and expand the service comes.

A fair and regular return on the money these stockholders have invested is an important factor in making possible the good telephone service you get today.

BELL TELEPHONE SYSTEM

MILITARY
SIGNALS
LAND ★ SEA ★ AIR

Journal of the Armed Forces Communications Association — Dedicated to Military Preparedness

VOLUME 4 SEPTEMBER-OCTOBER, 1949 Number 1

CONTENTS

FEATURES

DEPARTMENTS

Picture Credits: All pictures official Army, Navy, or Air Force photos unless otherwise credited. Photos, page 19, by Sylvania Electric Products Co.; page 32, by Trans World Airlines.

EDITOR
Brig. Gen. S. H. Sherrill (Ret.)

MANAGING EDITOR
Wallace R. Fingal

ASSOCIATE EDITORS
Capt. Ward Clarke, Hq. AACS
Air Force Communications News
Comdr. Guy M. Neely, U.S.N. Res.
Navy Communications News
Maj. Bruce Quisenberry, Sig. Corps, Res.
Signal Corps News

CIRCULATION MANAGER
A. R. Lorah

ADVERTISING REPRESENTATIVES
Woolf & Elofson, Inc.
70 East 45th Street
New York 17, N. Y.
Tel. ORegon 9-5188
854 Hanna Building
Cleveland 15, Ohio

SIGNALS is published bi-monthly by the Armed Forces Communications Association at 1624 Eye St., N. W., Washington 6, D. C. Entered as second-class matter at Post Office, Washington, D. C., September 6, 1946, under Act of March 3, 1879. Additional entry at Baltimore, Md.

Subscription rates: 1 year (6 issues), $5.00. To foreign post offices, $6.00. Printed in U.S.A. by Monumental Printing Co. at Baltimore, Md.

The publisher assumes no responsibility for return of unsolicited manuscripts or art. Authors are responsible for opinions expressed in articles.

When sending change of address, please list both the old and new addresses, and allow 3 weeks for delivery of first copy.

THE COVER

The cover photo of the Defense Department secretaries was posed specifically for SIGNALS, as was the Jan-Feb 1949 cover of the joint chiefs of staff. Both color photos were made by the Army Pictorial Service.

L to R are: Secretary of the Army Gordon Gray; Secretary of Defense Louis Johnson; Secretary of the Navy Francis P. Matthews; and Secretary of the Air Force W. Stuart Symington.

ELECTRONICS IN AIR DEFENSE

Possibly the foremost authority on the proposed radar "fence" around the United States, having headed the planning for that air defense device, General Saville describes here some of the problems of ringing the country with radar.

By Major General Gordon P. Saville
USAF Director of Requirements

Major General Gordon P. Saville has served with the U. S. Air Force since 1927. He has been specializing in air defense since 1940 when he was assistant intelligence officer and assistant training officer of the Air Defense Command which has its headquarters at Mitchell Field, N. Y.

He went to London as an observer in 1940, and returned there for service in 1941. Later the same year he returned to Mitchell Field where he became director of air defense. Overseas again in 1944 he commanded the air forces in the invasion of Southern France.

At the end of the war Gen. Saville resumed the post of director of air defense at Mitchell Field and held that position until September 1st of this year when he became Air Force director of requirements at USAF headquarters in Washington.

Without "electronics" in its broadest sense—the know-how, the equipment, and the skilled specialists—there can be no modern air defense. Our job is to kill enemy bombers, and our most useful tool for the job is the interceptor airplane. Yet the interceptor airplane, mighty weapon that it is, with its speed, range and tremendous fire power, would be helpless without electronics.

In the first World War, airplanes of wood and cloth travelling at a fraction of the speed of sound were sent out on the legendary "dawn patrol". The object of air war then was to shoot down enemy fighters and artillery observers. Perhaps the most important contribution of air power in its infancy was to raise the morale of ground troops, spectacular dogfights over the front lines resulting in flaming kills.

Dogfighting in WW I

Thousands of miles were flown by young men scanning the horizons for a telltale glint of the enemy in the early morning sun. Without air-ground radio, the fighter pilot was a free agent, out of touch with his base from the moment he took off. It was an age of chance encounters, of brilliant dogfighting, of man against man and machine against machine—but the machines were still primitive. In all of World War One, fewer bombs were dropped than the Eighth Air Force delivered over Germany in a single day of World War II.

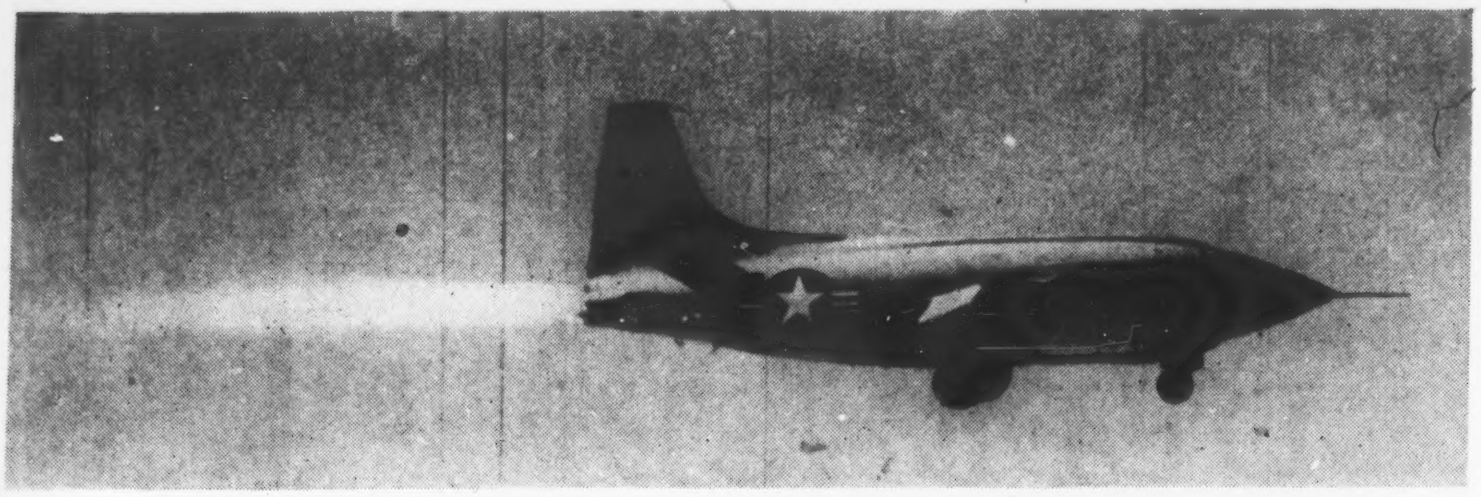
In the years between world wars, the great nations studied air warfare and began to understand the possibilities of aerial bombardment. More lethal bombers were developed, with increased speed, range, and bomb-loads, able to operate reliably at night. Military staffs, in searching for a suitable defense against this new weapon, relied heavily on the interceptor airplane. The interceptor had the necessary speed advantage over the bomber, and, unencumbered by a bomb-load, it could outmaneuver and outclimb him while still carrying guns to shoot him down, *provided the fighter could find the bomber!* But it soon became obvious that the defending side in the air war still suffered from all the classic handicaps of the defense: not knowing when and where the attack would come meant flying on patrols, a great waste of men, aircraft and fuel.

Economy Required Change

Some method had to be found to employ fighters more efficiently. In fact, the fundamental law of air defense is economy. In peace or war, every decision, every step we take, is influenced by the economics of the situation. In peacetime, this economic limit is enforced by dollars in the budget; in wartime, by the shortage of manpower, critical materials or manufacturing facilities. It was clearly evident that the greatest single step which could be taken in the direction of economy of force would be to switch from the air alert "dawn patrol" method of operating fighters to ground alert and ground control. Electronics was to make this possible.

The first feeble attempts at operating under ground control took place in the early 1930's. Efforts were made in Europe and in the United States to organize networks of airplane spotters who telephoned reports of enemy aircraft to a central point from which fighters could be dispatched to meet the threat. By now air-ground communications had become a reality, and it was possible to change a fighter's direction after he had taken off. But airplane spotters at best could detect and report airplanes only a few miles away. The requirement existed for a device which could detect and locate aircraft at ranges greater than the human senses permit.

The story of radar is too well known to bear repeating here. Suffice it to say that the basic phenomena were observed in the earliest days of wireless, and that their specific application to



Voice radio has become too slow to transmit flight information now that planes like the XS-1 above, have reached speeds rumored at hundreds of miles faster than the speed of sound . . .

military purposes came about, apparently independently, in Britain, the United States, and Germany, shortly before the outbreak of World War II. The Battle of Britain, a major turning point in the history of Western Civilization, was won by the marvelously timed, infinitely complex air defense of Great Britain. This defense depended on electronic warning. It was held together by electronic bonds which carried the never-ending stream of information and orders instantly to all parts of the far-flung ground system, and to the aircraft in flight. And more, radar was being made small enough to fit into night fighters, so that a pilot directed to the vicinity of his target by ground radar control (GCI) could make the final approach and sight on the target using his airborne intercept (AI) radar.

First Big Test

The Battle of Britain was a decisive and thorough test of the fighter-radar team, and the team was firmly established. Although improvements were made in the system throughout the war, a basic, and successful, pattern of operation had emerged. We adapted that pattern to the establishment of an air defense for the United States and our overseas bases, to tactical air operation on the European Continent and to the defense of our carrier task forces, but never again after 1940 were any of the allies attacked so fiercely from the air, by so numerous, clever, and able a foe.

As the tide of war turned and the threat of air attack on the Western Hemisphere receded, our fledgling air defenses of the U. S. were dismantled without, fortunately, having had to meet the test of combat. Rapid technical progress had made the electronic equipment of those systems obsolete in any case. But even the buildings and facilities, the elaborate camp sites and the specially constructed control centers and command posts were given up in the "demobilization."

Nineteen forty-nine is a fateful year for air defense. Four years have passed since the atomic age burst into the public consciousness at Hiroshima. Five years ago Anglo-American shuttle bombers pulverized the heart of Nazi Germany, and yet the downfall of the Axis, instead of ushering in the long-awaited peace, appears to have brought on no more than a regrouping of contestants. The President's Air Policy Commission and the Congressional Air Policy Board have estimated that other nations might have atomic bombs in useful quantity by 1952. And in March of 1949, the President of the United States signed legislation authorizing the re-establishment of a continental U.S. Aircraft Warning System.

Now that we have started the long road back, the question might well be asked—What have we learned? Which blind alleys can we avoid? In short, how does the situation differ now from those hectic days in December 1941, when every flight of gulls looked like a squadron of Stukas to our coast watchers?

The situation has changed far less than one might think at first glance. The phantasies of push-button warfare, rampant in 1945, have been relegated to their proper place. The lessons of the late war have been digested somewhat, and some fairly sober estimates of the technical "state of the art" have been made. There is a bitter gap between ideas on a drawing board and a useful military machine, available in significant amounts, with the people to operate and maintain it, with its supplies and spare parts.

We are not discrediting the intercontinental ballistic rocket—but we are only attempting to put it into its proper place on the time scale. Our problem is difficult enough as it is, just devising effective countermeasures against the modern, high speed, high altitude bomber.

No Lavish Radar Use

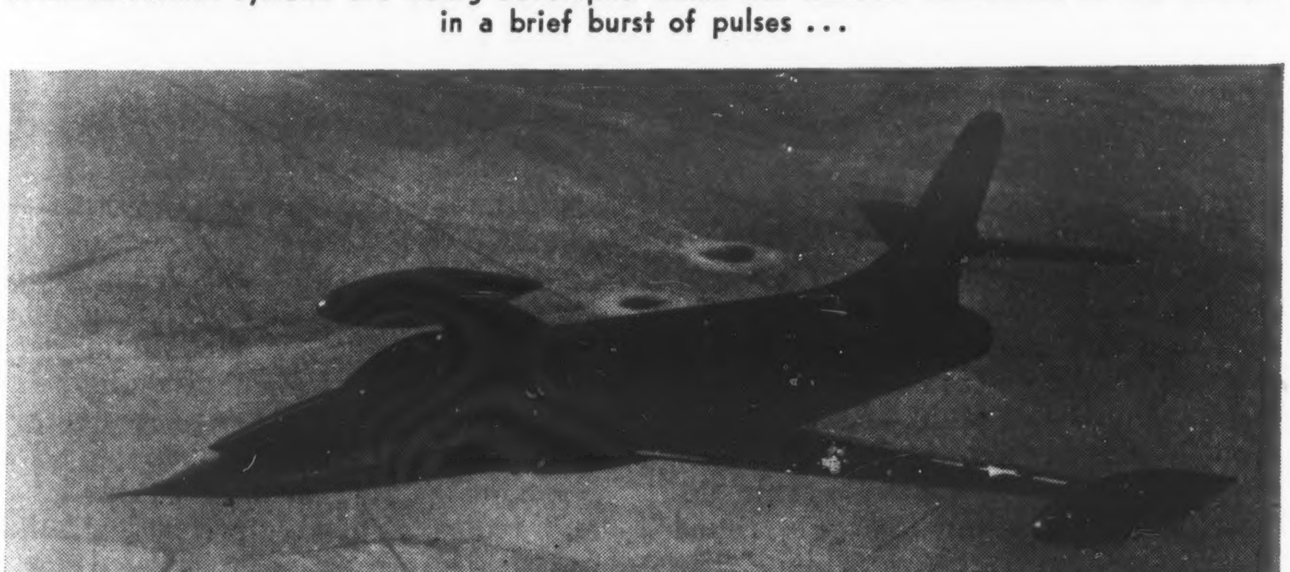
The basis of all air defense is timely accurate, and continuous information of the air situation. Radar is by far our most potent tool for acquiring this information at great ranges, high altitudes, and under all conditions of visibility. We have continued intensive radar development since the war, but radar is still plagued by the curvature of the earth; low coverage at any distance is poor.

The need for economy prohibits lavish deployment of radars to provide continuous low coverage. Hence the 1930 model ground observer is still very useful in clear weather when enemy bombers can really hedge-hop. Trained ground observers, properly deployed, can provide good tracking information at low altitudes. In poor visibility the ground observers effectiveness is sharply reduced, but conversely the bomber must fly much higher to clear terrain obstacles safely, and therefore will be seen more easily by the radars.

Push-Button Age Not Yet

Although the radically new weapons of the push-button age are still some time away, the speeds and altitudes of conventional bombers have nearly doubled. Equally great improvements are being brought about in fighter performance, and the ranges of our radars are being increased to almost their

. . . and like the needle-nose F-90, also busting through the sonic barrier. Automatic pulse communications systems are being developed which will transmit commands to the aircraft in a brief burst of pulses . . .



. . . a different world from that in which WW I airplanes took off without benefit of radio, or other electronic aids, to make chance encounters and fight their individual dogfights.

maximum theoretical limits. Of all the elements of our complex, elaborate "Battle of Britain" type air defense systems only the human element remains virtually unchanged. In the heat of battle, men introduce errors and delays which are intolerable in the control of tomorrow's interceptions, where bomber and fighter are approaching each other with a closing speed of twenty miles a minute.

The familiar colored arrows and "Christmas Trees" with their mysterious numbers and symbols, being pushed about on large scale maps to represent the track of an enemy bomber, have joined the crossbow and the catapult in military oblivion. The gathering, display and evaluation of air information must henceforth be handled automatically at electronic speeds. Computation of intercept courses must be henceforth performed not in minutes but in microseconds.

Voice Radio Too Slow

To evaluate the air situation correctly and compute an accurate intercept course at the ground control station quickly is but half the battle won. We must now scramble our aircraft and transmit subsequent orders instantly. In World War II this was done by voice radio. Today, speech is too slow and too subject to misinterpretation. Automatic pulse communications systems are being developed which will transmit commands to the aircraft in a brief burst of pulses, beamed to a selected recipient, automatically acknowledged and visually displayed to the pilot. These "private line" communications facilities will be positive in action and greatly improve the reliability of what was a very weak link in the system, most susceptible to jamming.

Paralleling improvements in our warning and control system, we must endeavor to create active air defense weapons which are as advanced as possible. When the areas to be defended are large, and the number of weapons which can be allocated to their defense is small, a great premium is placed on the effective range of each weapon. Today, the interceptor airplane offers us greater range and tactical mobility than either conventional antiaircraft artillery or the infant ground to air guided missile. But the interceptor has certain limitations at low altitudes and it requires more warning time than guns or missiles. In a well-designed large area defense there is a very definite place for all three weapons.

Air Defense Never Complete

The performance of the interceptor itself is one of the most vital factors in the overall air defense system. It must be based on the warning and control environment in which the aircraft operates and pointed at the enemy it must kill. We consider the job of producing bomber kills to be one unbroken, interrelated series of events, from the time the most far-flung radar in the system detects the bomber's approach until he crashes in flames. As we see it, we must treat the design of the interceptor as a systems problem. We must build a *fighting* machine, not just a flying machine. Our latest designs attempt to utilize the most advanced techniques in aerodynamics, propulsion, armament, automatic flight control, radar and communications, to produce the most lethal aerial weapon ever known.

However, even though we may achieve all this, air defense will never provide complete protection against air attack. The enemy can always exploit advantages inherent in the offensive. He can concentrate his attack in time and space so as to saturate any economically feasible defense. If we attempted to provide sufficient air defense to all of the continental United States, or even to only those parts of the country which provide attractive targets to a potential aggressor, we would exhaust the national economy many times over.

Defense "Raises Ante"

It is equally dangerous to disregard air defense completely, thereby offering the free exploitation of the airspace over our homeland to all comers. The resources devoted to air defense can pay great dividends up to a certain point, but can be more profitably applied elsewhere after that point. For example, by its very presence, it forces the enemy to employ more sophisticated offensive means. In other words, air defense "raises the ante"—it prevents unmolested attack by an enemy air fleet of obsolete transports.

And so, we in the United States Air Force are squarely between the devil and the deep blue sky. On the one hand, we must see to it that not too large a portion of the country's resources is consumed in providing the relatively specialized weapons of defense. On the other hand, a start must be made—our survival as a nation may be at stake. Especially must we begin to build up that basic frame work of an air defense system—the radar and communications net. Even without active weapons to engage the enemy, timely electronic warning, gathered and disseminated to areas in the path of an attack, by the aircraft warning system, might save thousands of lives.

Late War Development

As Air Force officers, we can analyze and plan, state the need to the Congress and the people, organize and test and reorganize, to make sure that our final integrated system is as effective as its component parts will allow it to be. But in the final analysis, the system is completely dependent upon electronics know-how. To help us plan, develop and procure our electronic equipment, we have the part-time help of some of this country's foremost scientific talent in the Research and Development Board. We have some fine technical groups at our Air Force laboratories.

But the problem is so vast that by far the greatest part of the burden must be borne by patriotic scientists and engineers in universities and in industry. Some might deplore this, believing that the military should build up a large technical staff of its own. I, on the contrary, feel that our present course is but a modern example of democracy in action. As long as the people are kept intelligently informed of our objectives, and the technical groups who cooperate with us are treated with reason and understanding, no nation on earth can hope to surpass us in that integration of technology, strategy, imagination and courage which will keep us free.

EDITORIAL

COMMUNICATIONS AND AIR POWER

The United States Air Force has assumed a position of commanding importance in the military structure of the United States. This growth and development of the Air Force has been based largely upon three characteristics which distinguish air power from land or sea power—namely: the speed, range, and fire power of aircraft—fire power in this instance being the delivery of bombs and missiles on specific targets, as well as firing of weapons from the aircraft. Air power is exercised through the exploitation of these three basic factors. The communications and electronics systems must keep pace with the ever increasing speed and range of aircraft to permit their effective employment.

The USAF has already operated aircraft which have exceeded the speed of sound; large numbers of USAF aircraft in daily use normally fly at high subsonic speeds closely approaching the so-called "sonic barrier." To cope with this type of operation and to be prepared to combat similar operations by any potential enemy, special attention must be given to increasing the speed of Air Force communications.

When an aircraft can traverse the continent in under four hours, as the B-47 recently did, it is obvious that the message announcing the departure and expected time of arrival of the aircraft should cross the continent in less time if it is to be of any practical use. The traditional type of message handling does not regularly provide this kind of service. Accordingly, the USAF has had to organize its communications especially to cope with this problem.

Similarly, jet fighters flying at their normal cruising speed outrun the range of their VHF radio equipment before the airways station contacted can secure badly needed weather information and relay it to them; this has necessitated provision of facilities permitting the jet pilot to talk directly to the weather office to save time. Advances in aircraft speeds have made it necessary to provide faster and more complete service. The Air Force communications system must be designed to meet the Air Force requirement for extremely rapid communications.

There was a time, not long ago, when heavy bombardment aircraft of the Air Force were considered to be stretching their usable range when they bombed the heart of Germany from bases in the United Kingdom. This era was shortly supplanted by operations from China and the Mariannas in which B-29's made strikes at ranges of 1500 miles—an unprecedented distance. Today, ranges in excess of 5000 miles are not unusual.

If contact is to be maintained with aircraft operating at such ranges there must be an increase in the range of our ground/air stations, and a global distribution to insure continuous control. Where 500 watts was adequate to contact B-29's with trailing wire antennas at 1500 miles, power on the order of 10 KW is required when aircraft range is extended to 5000 miles and the high speed of the aircraft precludes using a trailing wire. Moreover, ranges such as those presently attained make trans-arctic operations feasible, thereby introducing another difficulty to the communicator—the unreliability of normal high frequency circuits in polar regions due to auroral absorption. It is necessary to combine very low frequency circuits in the networks. This increase in range and scope of operations has necessitated complete revision of the communications systems used by the Air Force in World War II so as to permit contact with USAF aircraft which are constantly reaching farther and farther from their operating base.

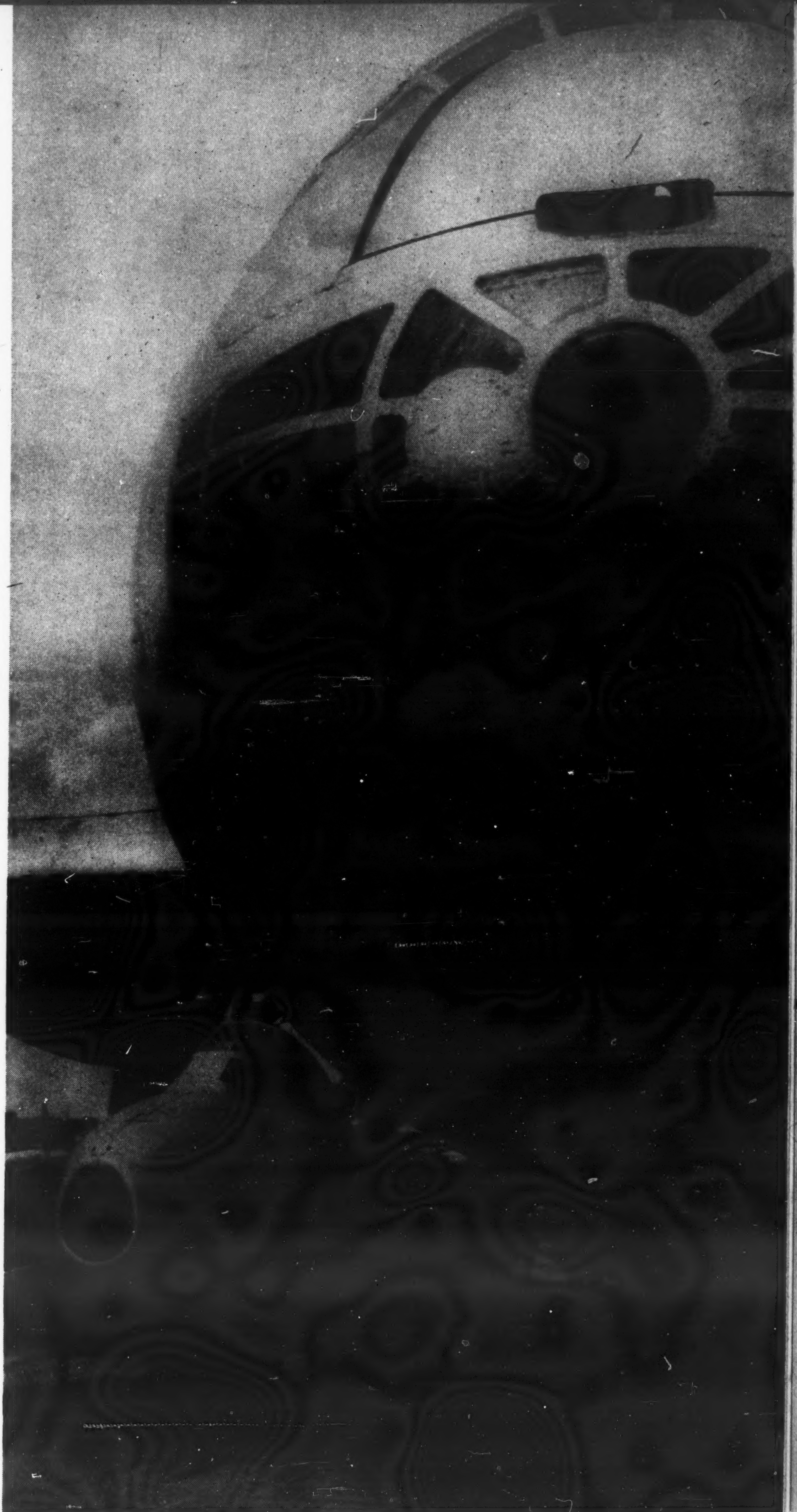
All this speed and range will have little effect upon a military action if they are not employed to deliver fire power. Similarly, vast quantities of fire power, even the atomic bomb, cannot affect a military decision if wasted upon an ocean waste or an arctic tundra. It is essential that the fire power be delivered accurately upon a selected target. To do so requires precise navigation and accurate bombing and gunnery.

The requirement to deliver effective fire under all conditions of weather and visibility has lead to many complex electronic navigational devices to guide our bomber and fighter aircraft, together with electronic bomb and gun sights. Daily, these devices are being improved; their use is becoming more widespread to the point to where a substantial portion of the cost of our heavy strategic bombers is represented in electronic and communications equipment. The effective employment of fire power is dependent upon the precise functioning of the complex Air Force communications and electronics systems and equipments.

The Air Force communications and electronics specialist must constantly keep in mind these three basic commodities of air power; speed, range, and fire power. Only through the development and exploitation of communications and electronic systems especially designed around these three commodities can the USAF perform its mission as the first line of the nation's defense.

Maj. Gen. Francis L. Ankenbrandt
USAF Director of Communications

PHOTOS



The little fellow looks as though he's parked under mammy's wing for protection. But actually it's he who does the protecting, for he's a fast moving little toughie.

The owner of the big nose is a B-36. Which should be obvious, for what other plane has as big a nose! The midget is the experimental jet F-85 designed to be carried by, launched from, and picked up again by large planes. With that as its method of operation it doesn't have landing gear, and that's why it is resting on that cradle in the photo.

Assembly line methods of producing photographic prints have gone into effect at the Air Materiel Command engineering division's photographic laboratory, Wright-Patterson Air Force Base. Aerial strip film and photographic paper advance automatically through this newly developed photographic multiprocessor (left), the paper passing through chemicals, washes, and an infra-red drier, coming off at the far end ready to be cut into individual 9 x 9 or 9 x 18 prints.

By changing solutions in the tanks and making minor adjustments the multiprocessor can be used for processing aerial strip film, or, by adding necessary tank sections, can be converted to handle Ansco or Kodacolor prints.

Outstanding feature of the "packaged" processor is its adaptability to installation in the C-120, the "flying boxcar." The 400 feet of floor space in this aircraft provides ample room for a complete photographic laboratory which would be ready for use as soon as it is flown into a desired area.

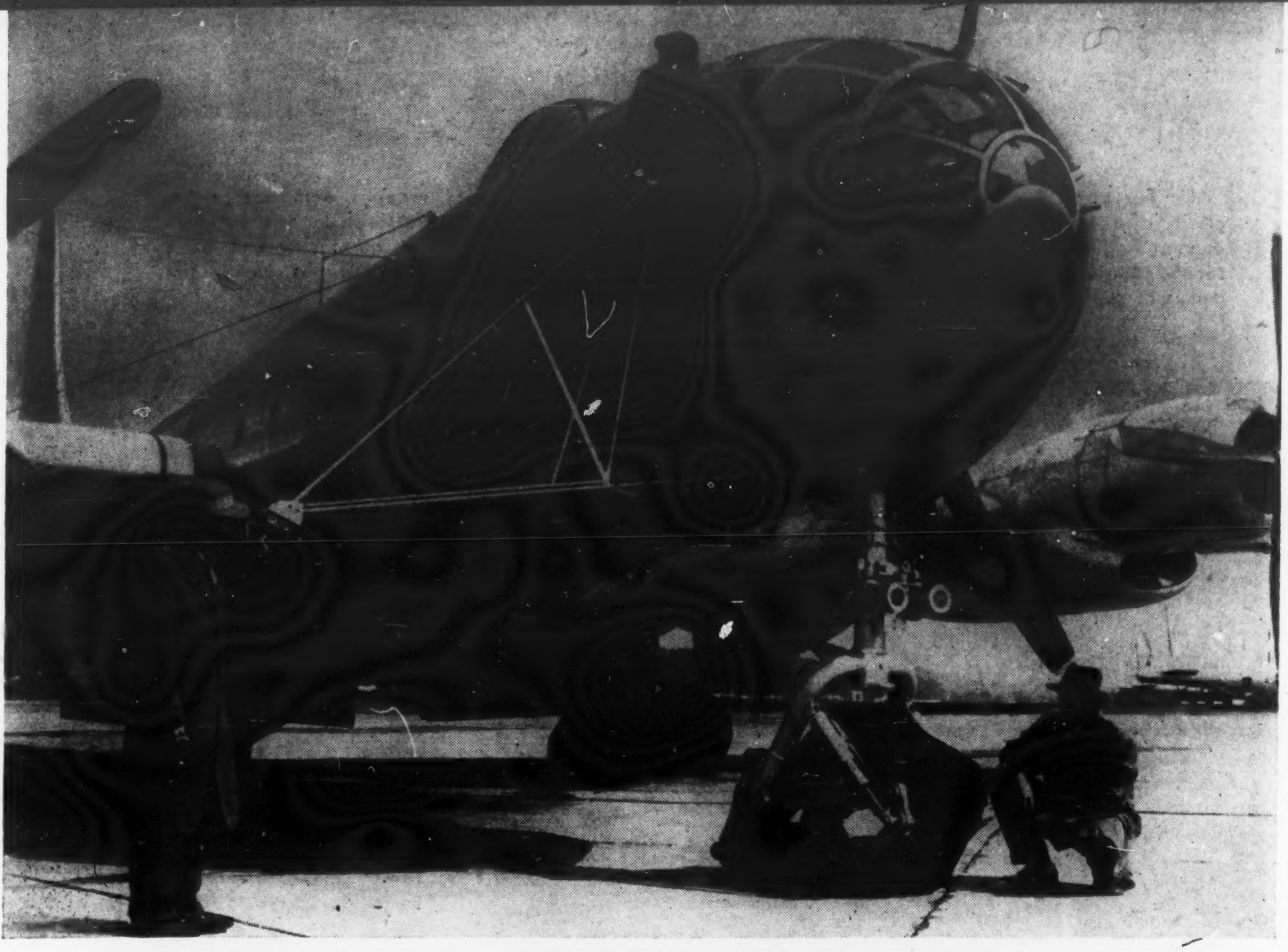
Right: The aerial strip film and photographic printing paper stacked up here represents one day's output for the newly developed multiprocessor. Standing by the stack of paper and film to indicate its height, is Virginia Bingham, secretary at the Wright-Patterson photographic laboratory, who measures five feet four.

The new device is capable of turning out approximately 20,000 completed prints in a single day, and can process black and white negatives at the rate of 600 feet an hour.

Measuring 31 feet long, 17 inches wide, and five feet high, the multiprocessor is made up of separate units which contain previewer, printer, developer, spray rinse, hypo bath, wash tanks, and infra red dryer. For shipment the entire processor packs into 16 boxes, none of which is over six feet long, and each of which can be carried by three men.

The machine, designed in collaboration with engineers of the AMC photolab, was built to specifications by Technical Services, Inc., of Plymouth, Michigan, and is the only one of its kind to date.

AMC photo lab officials point out that not only does the automatic operation of the multiprocessor take the guess work out of printing, but its speed of operation permits greater production with fewer trained photographic personnel.



Photography is utilized to record action of tractor-tread landing gear being tested by the Air Force for use of heavy aircraft on unimproved fields. The tripod attached to the plane's nose holds motion picture camera equipment to automatically record action of the new gear during high-speed tests.

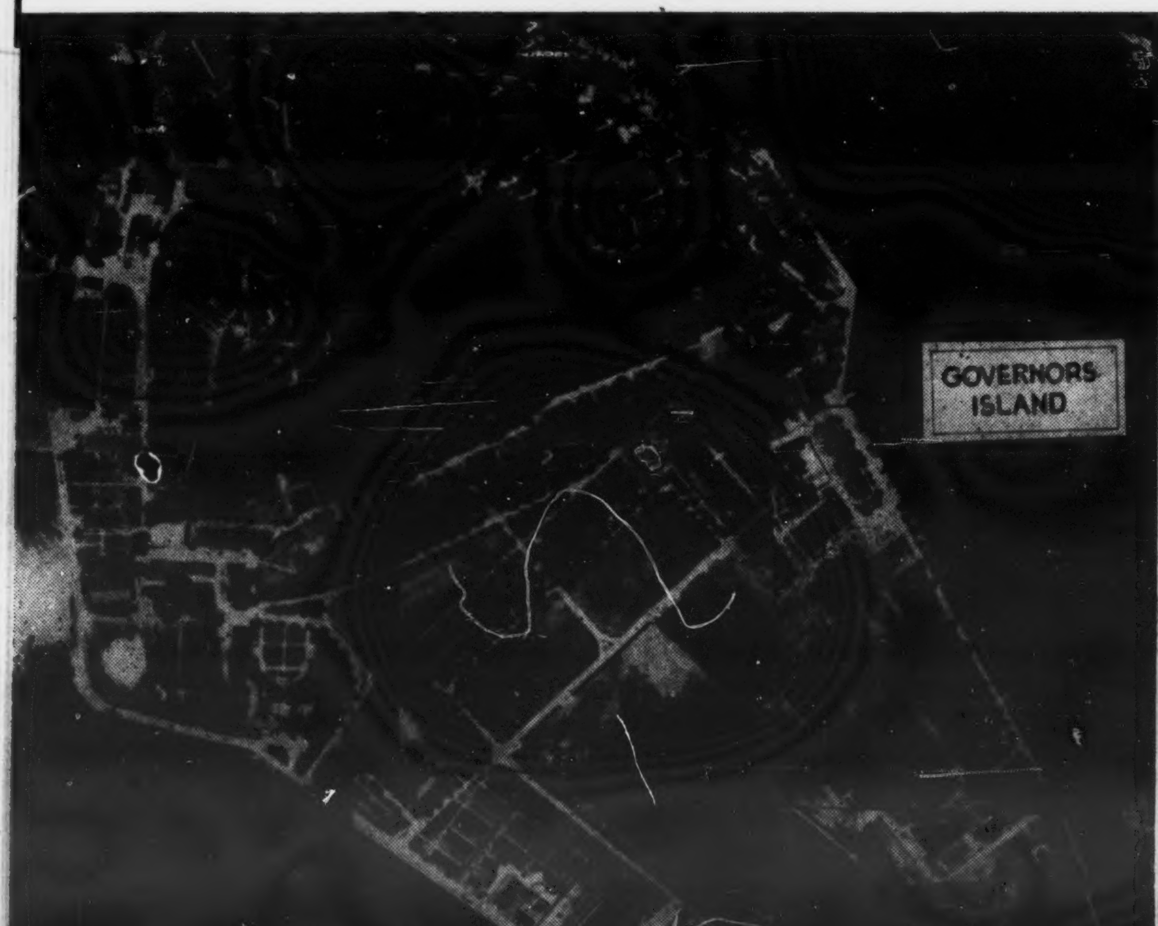
The airplane in this photo is a B-50, and the track-treads are the largest installation of its type yet made. The treads have a footprint area three times that of the usual double-tire landing gear of the B-50. Each unit consists of an endless rubber belt, which rotates around a series of grooved drums and bogies, much like an Army tank. The main landing gear units each have twin belt and drum assemblies. The nose gear consists of a single belt system.

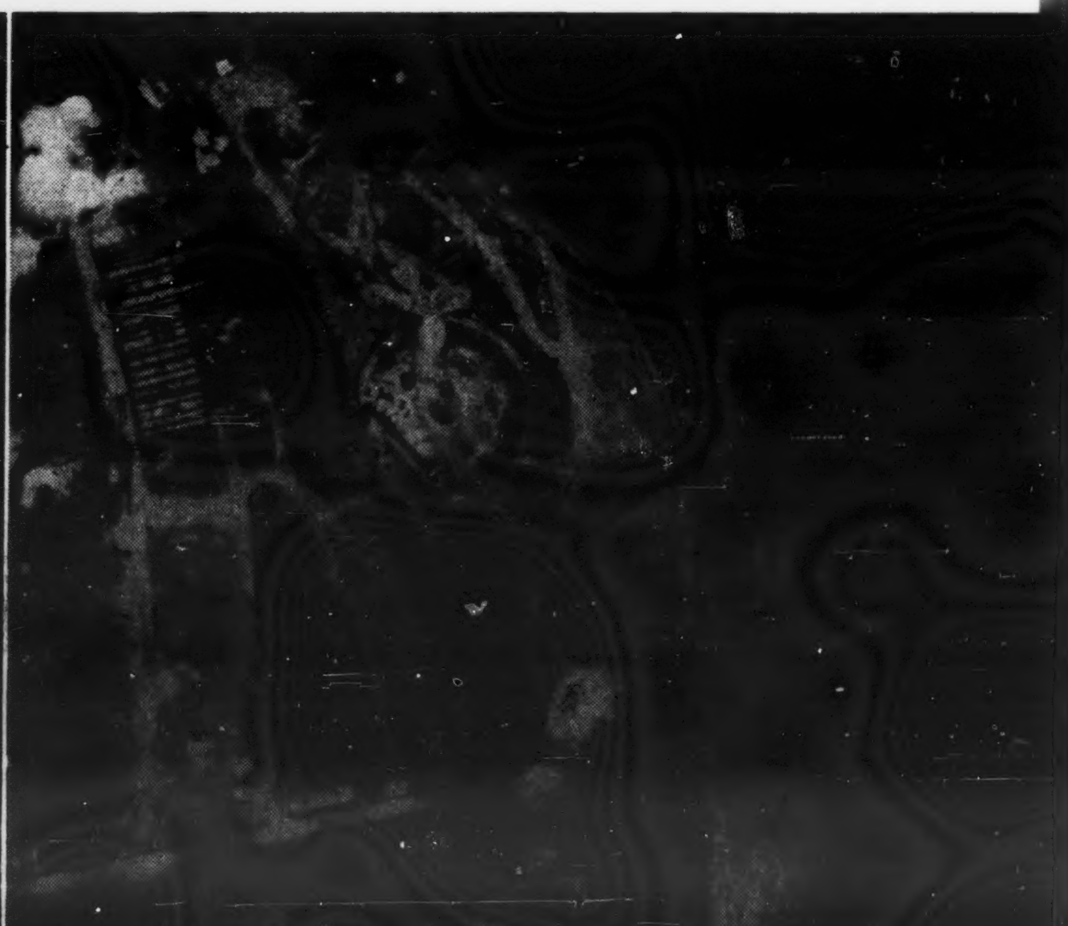
The pilot's "office" keeps getting further away from the engines on the new giant planes, so that already it has become necessary for a ground observer to use telephone communication to report to the crew on pre-flight engine warmup. In this photo the observer is using the plane's interphone to report that number 4 engine is "revving up" satisfactorily.

The plane is the Air Force's C-99, world's largest land cargo plane, a sister ship to the B-36 bomber. The C-99 lifts a gross of 265,000 pounds and can carry over 400 fully equipped troops.

Air Force night aerial photographs taken over New York City. These mosaics demonstrate the clarity of detail possible from the Air Force's K-24 aerial camera in conjunction with its new fourteen ounce, 50,000,000 candle power flash cartridge. Although lasting for only one-thousandth of a second, the illumination makes it possible, by "blowing up" sections of the photographs, to identify makes of parked automobiles.

Three K-24 cameras set in a tri-metrogen mount made it possible to take one vertical and two oblique shots for each of the light-weight flash cartridges that were exploded. A total of four cartridges were used in producing the upper photo, and a total of three for the others. Greater area coverage is possible per flight minute by using tri-metrogen cameras. The K-24 was patterned after RAF cameras which were used late in World War II. Its F2.5 lens has a focal length of 7½ inches, and lacks the conventional camera shutter. The lens shutter is opened before, during, and after the one-thousandth second flash. This accounts for the light streaks which appear in the photographs.





By Col. E. Blair Garland
USAF

The SIGNAL AIR-GROUND LIAISON COMPANY

The scene is somewhere in an Army-Air Force area in World War III. "Johnny' Johnson, the G-3 (Air) of one of the divisions hears his telephone ring.

The voice on the other end of the wire sounds harassed and slightly worried. It's the S-3 at one of the regiments.

"Say, Johnny, this is Bill at regiment. We're not moving as fast as we expected. Lots of opposition all along the front. Have a gun battery in a well-concealed and covered position at T163812. Just spotted by one of the egg-beater fly-boys. The artillery has given it the works but it's still raising hell with us. Can you get a couple of jets on it for us right away?"

Johnson gets the full details, looks at his map, writes on a standard prepared form the necessary information concerning the target and hands it to the radio-teletypewriter operator of his signal air-ground liaison company team. In less than two minutes the same message is taken from the radio-teletype writer at the joint operation center at Army-Air Force level and is handed to the G-3 (Air) for action.

The G-3 (Air) consults his map. checks his other requests for air support and decides it is a suitable target, hands it to the Air Force A-3 on duty next to him in the joint operations center. The A-3 recalls that he has a flight of three fighter-bombers about to take off on an armed reconnaissance mission. He approves the request and the G-3 (Air) notifies the requesting division. The A-3 picks up the telephone, calls the group operations officer, gives him the details of the mission and the jets are on their way. They check in with the forward air controller on duty within the regimental area and with his assistance make a run on the gun battery. The second time over. they spot it and down go their eggs. The mission is a success and the regiment quickly takes advantage of the silenced guns.

This episode is used to illustrate the rapid, efficient communications network that air-ground cooperation requires for the passing of immediate air support requests as well as other vital combat information.

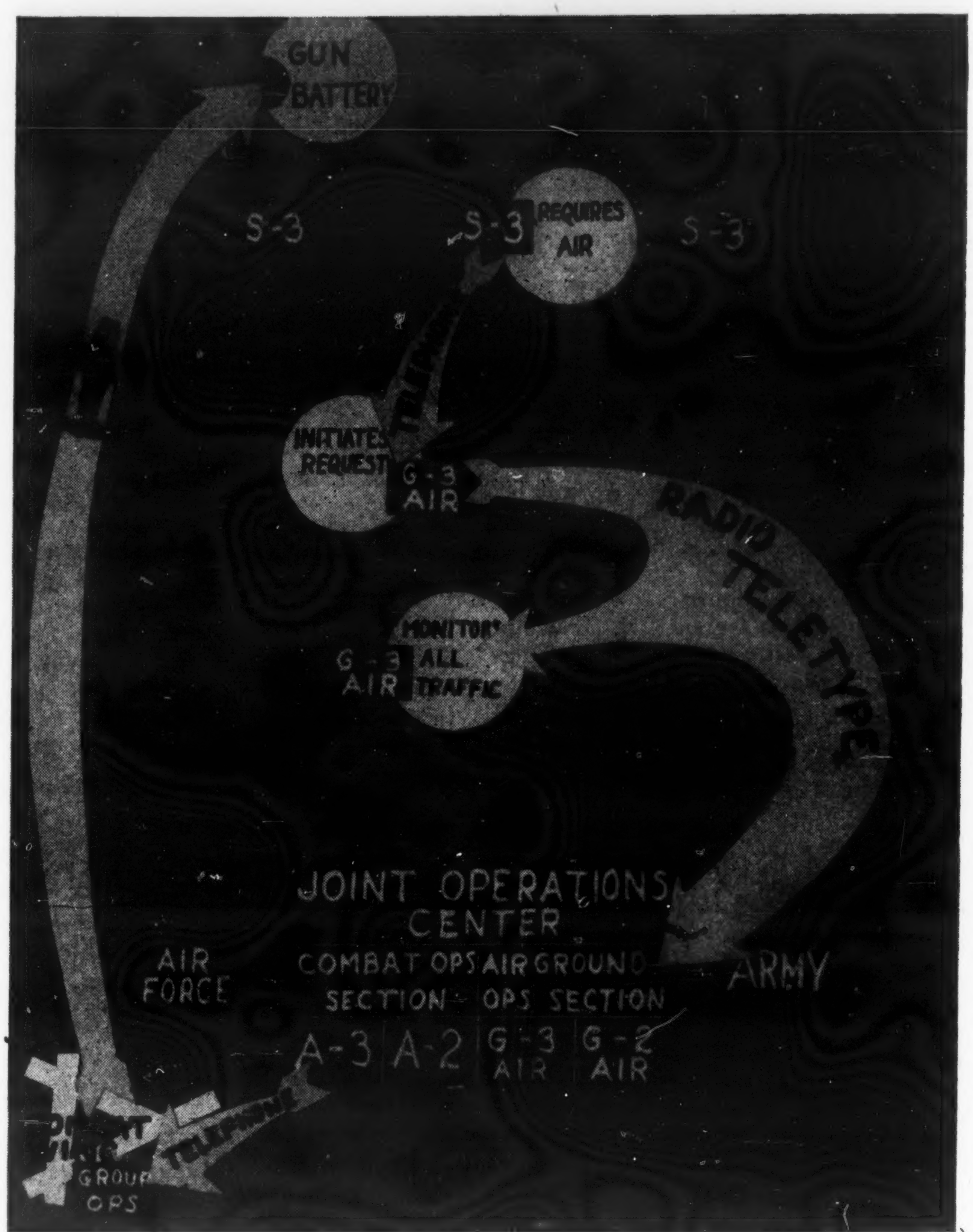


Chart I.

Late War Development

The organization, known as a signal air-ground liaison company, is a little known but extremely essential unit of the Army field forces. It is interesting to note that it is one of the few units actually created near the termination of World War II, and strangely enough, has brought about a situation within the Army field forces that is diametrically opposite to the normal situation brought about by integration of the services. Where it has been customary for the Army field forces to turn over responsibilities to the air forces, in this case the creation of the signal air-ground liaison company has given the air forces an opportunity to turn over a responsibility to the Army field forces.

To more fully understand this responsibility, it is well to go back over the historical events which produced the requirement for such a unit and its metamorphosis from the air support control squadron, a former Army Air Force unit to the signal air-ground liaison company, presently an Army field force unit.

In the early part of World War II, before the United States became involved, the majority of American military men were amazed and shocked at the devastating blitzkreig tactics employed by the German military machine. And machine it was, with the German Army rolling over Belgium and France in May and June of 1940. Nothing appeared more overwhelming or more potent than the close support between the German air and ground forces in combat.

The German air forces shattered and demoralized all opposition so that the German armies were able to strike with lightning-like blows. The majority of the Allied countries had either permitted their close-support doctrine to lag

far behind that of the Germans or had, like the United States, failed to develop one. The United States, had not only failed to develop a tactical doctrine but what was worse, had failed to develop equipment even remotely suitable for close air support.

With the success of the Germans so plainly based on this close air-ground relationship, both General H. H. Arnold, then chief of the Air Corps, and Gen. Lesley J. McNair, the chief of staff, GHQ, decided it was time the air forces and ground forces got together and developed a doctrine and the tools for making it effective in combat. Time was running out. During the first half of 1941, tests of tactical air support were held in the East by the Third Air Force and the Third Army. They involved the 17th Bombardment Wing under General Louis H. Brereton and the IV Corps commanded by General Jay L. Benedict.

Intolerable Lapse

From these early exercises, which brought to light more shortcomings and deficiencies than can be readily stated, with particular emphasis on communications equipment and procedures, evolved the first real tactical air doctrine. Five air support commands containing all air support type aircraft were created, one for each U. S. army and one for the armored force. The doctrine conceived was set forth in training circular No. 52, 29 August 1941, "Employment of Aviation in Close Support of Ground Troops."

In September 1941, what was called "the most spectacular" exhibition of tactical air power ever seen in the United States was demonstrated in a maneuver involving eight Air Force groups and seven Navy squadrons. As in the previous maneuver, difficulties arose from poor communications. An undue length of time elapsed from the ground commander's request for air support until it was delivered at the target, a lapse which could not be tolerated.

Early Plan Combat Utilized

The doctrine which began to emerge from these maneuvers was somewhat like this: Air support would be arranged for at subordinate levels between air and ground officers by liaison means. Each corps headquarters[1] would include an "air support control," a group of air and ground officers in direct contact with both lower ground units and an air support command. Each lower headquarters, down to the level required by the tactical situation, would include an "air support party," a highly mobile team composed of one or more air officers in direct contact with the air support control.

[1]After combat experience with larger units, it was realized that corps was too low a level when armies or army groups were involved.

Within the corps, air support parties would rarely be detailed to a headquarters below that of an infantry division except when a regimental or battalion combat team was performing a special mission. In the armored and cavalry divisions, they would frequently be detailed to regimental or battalion level to meet the requirements of rapid movement. The air support parties could pass only requests approved by the ground commander and only to an air support control. It is interesting to note how closely this basic doctrine was followed in actual combat in Europe in 1944-45.

To support this doctrine, a system capable of operating as follows was required. A request for air support from a forward ground unit was passed back through command communications channels until it reached a headquarters where there was an air support party. The request was first coordinated with the ground commander at that level and if he deemed it a practical request, and approved it, the request was sent by the air support party radio to the first command post having an air support control. This might be at division or corps level. If the air support control officer decided the request was a reasonable target for air attack, he forwarded the request by radio through the air support command as a directive to one of the fighter groups for action. It is evident that under such an arrangement each corps or even each division would have in effect its own supporting "air force."

Air-Ground-Talk Dispute

All communication from the air support parties to the air support control and from there to the airdromes would be by HF CW radio. It was even contemplated that the air support parties and air support controls might be able to talk to the aircraft in flight. It is hardly conceivable today that as late as 1943 considerable discussion was still taking place among interested staff sections of the United States Eighth Air Force regarding the practicability of low fast-flying aircraft talking to friendly ground stations while searching out hostile ground targets.

So much controversy arose regarding the effective range and power of command type radio sets that it was finally decided to keep both the HF command radio set[2] and the VHF command radio set[3] in all A-20 light bombers intended for air support work, if and when an invasion of the European continent should take place. The argument was quickly settled, however, when the first air support aircraft to arrive in England were P-51 fighters, which were equipped with the VHF radio set only.

By the summer of 1943, with the U. S. combat experience of North Africa in retrospect and the victorious operation of the RAF and General Montgomery's Eighth Army exemplifying air-ground operations, the composition of the air support commands became more evident. They now consisted of one or more air combat groups, an air support control squadron to provide the air support party and air support control communications teams, a light observation squadron, a photographic squadron, a signal operating and construction battalion and thought had been given to the addition of some type of radar equipment.

[2]SCR 274 N, HF voice radio set, power output 20 watts.

[3]SCR 522, VHF voice radio set, power output 8 watts.

Close Support Lack

Nevertheless, the close air support expected between air and ground forces during late '42 and most of '43 was in operation little or nothing. What little did develop was generally ineffective due to the long, slow communications channels and complex machinery required to put it into action. When the Fifth Army reached Salerno late in '43 its commander, General Mark Clark stated, "we are getting air help in the form of light bombers on our immediate front but the machinery for close support has not yet been effectively worked out." At the same time General Omar Bradley stated, "we can't get air when we need it and we're catching hell for it. By the time our request for air goes through channels the target's gone or the Stukas have come instead."

A corps commander stated, "when my tanks start rolling, the Stukas are over in twenty minutes. By contrast, our calls for airplane missions to meet a sudden combat development, get no real results for hours. The system of calling through two or three different headquarters for air support simply will not give the support desired at the time desired." Many other reports from ground commanders in Africa and Italy followed the same trend. The operational procedures and the system of communications in use were too involved for practical results.

Progress in Italy

The first real signs of progress came late in '43, between the Fifth Army and the XII Air Support Command in Italy. The two organizations had placed their headquarters in close proximity to each other and the Fifth Army funnelled all requests for air support from its lower units straight through to itself, where it evaluated them and coordinated them for the XII Air Support Command. It also kept its lower units informed as to what action was being taken on their requests. Thus the XII Air Support Command received the sifted air requests, already coordinated between all the ground units and approved by the Fifth Army for action. It then became strictly an Air Force problem to get the aircraft airborne and over the target.

This system worked well and much of its basic doctrine was later used by

the First U. S. Army and the IX Tactical Air Command, as well as the other armies and tactical air commands in Europe. Full credit must also be given to the experiences of the RAF and the Eighth Army in the North African desert for much of the practical part of the working doctrine. Note particularly, however, that in this system devised by the forces in Italy, the responsibility for transmitting the requests for air support and the replies thereto was placed squarely on the Army as it is today. In Europe, as will be described later, this was a responsibility of the Air Forces.

Much argument has arisen over which is the better method and strong arguments can be brought to bear on both sides. It is the perhaps biased opinion of the author that the method used in Europe was the more efficient in that the individuals concerned performed in a dual capacity and therefore less personnel were required.

Air support in the Philippines, showing a P-38 aircraft attacking a Japanese position immediately in front of advancing troops. The air support party officer is assisting the pilot to locate the enemy by radio mounted in the tank.

Peak Hit in ETO

With real progress being made at last in the procedures for providing air support, it is worth while moving to the battlefield of Europe and viewing it in some detail. Here, cooperation between the ground and air forces reached a pinnacle of efficiency; here, personalities, conditions and equipment were ideally matched to one another. One of the basic reasons for this successful cooperation was the speed with which the requests for air support by the forward elements of the armies were received and acted upon by the air forces. This was due to no new or novel discovery, but simply the outgrowth of the previous disappointing experiences and growing pains in Italy and Africa. It was in part dependent on the well-planned, highly developed communication network provided by the air support control squadron.

The air support control squadron, by now an integral and vital component of all air support commands, was organized under T/O & E 1-547, dated 18 October 1943. In 1944, when the air support command was redesignated a tactical air command, the squadron was redesignated a tactical air communications squadron.[4] This, then, was the air force unit charged with providing an air support command with the communications for the air support and airdrome parties.

The air support parties, consisting of one or more air support party officers[5] and several enlisted men, coordinated the requests for air support with the ground commanders and transmitted them from the divisions and corps to the G-3 (Air)[6] at the combat operations section at the Joint Air Support Command-Army Headquarters. In addition, they provided the means for communicating directly with the fighter aircraft while in flight and assisted the pilot in striking the target.

The second type of team, also furnished by the air support control squadron, was known as an "airdrome party." This was a communications team placed on each airdrome to provide communications between the ground liaison officer[7] (GLO) with each fighter Group and the G-3 (Air) at the combat operations section. These teams transmitted continuous and up-to-the-minute battle information for use by both ground and air. This information included the location of forward elements of the ground forces, location of bomb safety lines, information of the enemy obtained by both ground and air forces, capabilities of enemy and friendly ground forces, plans for future ground operations and information concerning results of ground operations and air missions.

When the squadron was redesignated a tactical air communications squadron as mentioned above, the word "control" was dropped and the word "communications" substituted. Although its function of controlling aircraft participating in front line air support missions remained unchanged, a new control agency had appeared on the scene and hence the necessity for a change in nomenclature.

Radar equipment which until that time had been of the large, unwieldy, fixed type for air defense operations, was found to be just as effective for directing offensive operations as for directing defensive operations. It was also found that the equipment though delicate in nature could be reduced in size and made rugged enough to mobilize for rapid movement over roads.

Before long radar became an integral part of the tactical air command through the agency of the aircraft warning battalion. Radar control required a central plotting board to show the location of friendly and hostile aircraft, as well as air-ground radio equipment to direct the pilots. In addition, a radio direction finding net was needed to offer navigational aid to pilots during combat missions. This equipment and the operating personnel were grouped together into a second unit known as a fighter control squadron. Hence, in attempting to avoid confusion in nomenclature the opportunity was provided for changing the name from an air support control squadron to that of a tactical air communications squadron, a much more significant name.

JASCO Unexpected Aid

In Europe, the IX Tactical Air Command, commanded by Major General E. R. Quesada, had been selected to support the First U. S. Army for the Normandy invasion and subsequent movement across the continent. The 6th Tactical Air Communications Squadron and the 8th Tactical Air Communications Squadron were assigned to the IX Tactical Air Command to provide the air support communications system.

Both of these squadrons, as well as the 4th and 11th, which were assigned to XIX Tactical Air Command under Major General O. P. Weyland were fairly well trained and equipped but without combat experience. Furthermore, they were at a decided disadvantage in that the ground units with

[4]These designations are somewhat confusing in that the original designation of air support command was changed to tactical air command just prior to the invasion of Normandy and is presently designated a tactical air force.

[5]Usually a rated officer with air combat experience.

[6]An assistant G-3 especially trained in the capabilities and limitations of tactical air.

[7]A ground officer with ground combat experience.

which they were to work were not located centrally in England but were scattered throughout North Ireland, Wales, England and Scotland. This prevented realistic communications nets from being set up so that training could commence. Instead, the communications teams were scattered in the vicinity of Middle Wallop, Hampshire, England and did their best to simulate what they felt would be actual combat conditions.

About this time a land fall occurred which had great bearing on the final success of the operations. An organization, known as a JASCO (joint amphibious signal company) arrived in England. Its role was, in general, the same as that of the tactical air communications squadron but only for the actual beach assault. After the assault was completed, it withdrew from action and the communications squadron took over.

Since it had already decided that the tactical air communications squadron could and would furnish the air support parties for the assault landings and thereafter, even down to regimental combat teams, there was no requirement for the JASCO. As a result, its personnel and equipment were divided among the four squadrons to give them additional strength. This was a real break and filled a dire shortage of personnel and equipment as more and more ground combat units were committed to action and more and more air support party teams were needed.

Invasion Plan

It is worth pausing for a moment to examine the air support portion of the plan for the invasion. Each regimental combat team taking part in the assault landing in Normandy, each corps and each division including the 82nd and the 101st Airborne Divisions were assigned an air support party. Emphasis, necessarily, was placed on radio communications since the invasion was an over-water operation and radio the only means of communication during the water crossing and until a bridgehead was established ashore. The scheme of employment was simple and practical and when the important day arrived worked well beyond expectations.

Three communications nets were established with the net control station situated outside of London at the town of Uxbridge. This was the location of the combined control center for the overall Allied command and control of the invasion. One network (telephone) linked together all the airdromes in England so that the combined control center could provide instantaneous battle information to the GLO's on these bases as well as pass the operations orders for ordering the aircraft into action. A second network included the combined control center, the Omaha Beach headquarters ship *Ancon* and the air support parties with the assault troops on Omaha Beach. The third network included the combined control center, the Utah Beach headquarters ship, *Bayfield*, and the air support parties with the assault troops on Utah Beach. The latter two nets were monitored by the Task Force Flagship, *Augusta*, aboard which was General Omar N. Bradley, commander of the U. S. First Army.

Beachhead Nets

A similar arrangement included the RAF airdromes, headquarters ships, and British ground units on the eastern beaches of Normandy. The air support party teams landed with the first troops on D-day and by D-3, the net control station of the 8th Tactical Air Communication Squadron was ashore and was ready to take over control of the beachhead nets. Each of the air support parties had been equipped with an SCR-522 VHF air-ground radio set for controlling friendly fighter aircraft and an SCR 284[8] HF radio set for working in the air support net. The sets with their batteries and tiny gasoline driven generators were mounted in special water proofed ordnance ammunition carts to keep them dry while coming through the surf and for easy movement over the beach. As soon as the parties were well established ashore they brought in their jeep mounted VRC-1 equipment[9] followed shortly thereafter by the SCR-624[10] and SCR-399[11] sets.

Among the first assault troops to land was a party headed by Lt. Colonel McWhorter, who received the Silver Star on D-day for heroic achievement and quick thinking. An enemy gun battery was inflicting considerable casualties among troops on his front and no immediate air support was available. By quickly dispatching a message to the headquarters ship he was able to give the coordinates of the hostile guns accurately enough that they were knocked out by the first rounds of Naval gun fire.

Improvement on Continent

As the battle on the continent progressed and the communications within the Army and the Tactical Air Command improved with experience, it was found practical and desirable to use teletypewriter communications for normal air requests[12] from divisions to corps and from the corps to the combat operations section at Tactical Air Command-Army level. This meant two-way telephone and teleprinter service direct between the combat operations section at Tactical Air Command level and the air support party officers at corps and direct telephone service from the combat operations section to the air support party officers at division. The circuits were provided by the Army Signal officer and the operating personnel and equipment by the tactical air communications squadron. This permitted the proper utilization of telephone and teletype writer personnel heretofore unemployed.

Further Evolution

Until the invasion, while the exact function of the air support party was still in the embryonic stages, it was envisioned that the communications used by the air support party officer would be entirely CW radio due to the distances involved and the rapidity with which the battle situation might change. Even though the T/O & E did provide telephone operators and teletypewriter operator-mechanics, lack of combat experience and uncertainty of wire circuits excluded their use. Now with the proven reliability of spiral-4 trunk circuits and AN/TRC FM radio circuits, the use of telephone and teletypewriter became the expected mode of operation. An influencing factor on this trend too was the knowledge that the Germans were monitoring all radio transmissions and hence made it necessary to encode all messages, a process not only tedious but which also delayed the transmission of messages requiring instant action.

The same thing was true with respect to the GLO's attached to the fighter Groups on the landing strips and airdromes. They found it much faster and much more efficient to pass information to and from the combat operations section by the normal tactical air command telephone and teletypewriter channels rather than using the slower encoding and decoding processes required by their radio teams. Only in emergencies would they have required their radio equipment and even then the fighter group could have provided it.

Air Support Teams

A glance at table 1 will show the detailed composition of the air support party teams and their equipment. It can be seen that the teams had expanded considerably from their early beginnings and the equipment, much of which during the early days had been improvised, was now provided in a satisfactory manner. The actual procedures employed in the final phases had become standard operating procedures.

One or more of these teams were attached to each corps and each division as the situation demanded. Each cavalry group when it was operating with fighter aircraft had one armored vehicle per squadron equipped with an

[8]Vehicular type 3.8-5.8 mcs. H.F. set.

[9]Equivalent to a VHF air-ground set and an H.F. point-to-point set.

[10]An SCR 522 set designed specifically for ground operations.

[11]High powered H.F. set usually mounted in an HO-17 hut for easy transportation in a 2½ ton truck.

[12]Radio was still the most expeditious means for immediate air requests.

SCR-522 VHF radio set. These sets were supplied by the tactical air communications squadron for the use of the air support party but were installed and maintained by the Cavalry group.

Similar equipment was placed in a sufficient number of armored vehicles of each armored division for use of the air support party officers when the Tactical Air Command was participating in coordinated action with the armored divisions of the Army. The first time air-ground communication took place successfully between tanks and column cover[13] aircraft in actual combat occurred at the St. Lo breakthrough in Normandy in July of 1944 when the 2d and 3d Armored Divisions' tanks spearheaded the advance of the First U. S. Army out of the hedgerows. The results were so impressive that General Bradley ordered all armored units on the continent to immediately adapt the SCR-522 set to their tanks for air-ground support work.

SAGL Co. Activated

Another interesting team supplied by the communication squadron was that attached to each of the Army artillery fire direction centers and each corps artillery headquarters to furnish VHF radio communication between artillery and high performance aircraft (fighters *not* liaison type aircraft) engaged in artillery reconnaissance. The communications squadron provided the ground equipment and the artillery units trained their own radio maintenance men to maintain these sets thus relieving the communication squadron of the latter responsibility.

This, in general, is the way the tactical air command squadron was employed at the end of the war. Meanwhile word had gotten back to Washington of the success of the methods employed in Italy and the doctrine developed was set forth in W.D. Training Circulars No. 17 and 30. The tactical air communications squadron with its air support parties was eliminated from the Tactical Air Command and a new organization, the signal air-ground liaison company, was activated within the Army. However, the function of this new company was drastically curtailed as it provides only the communications team for the net control at Army-Air Force level and the communications teams at division and corps level for the passing of air requests by the lower ground units. It does not provide an air support party officer at each level and thereby requires an air liaison officer, whose sole function is air advisor to the ground forces commander.

The ALO has no control over aircraft or over the air missions but serves merely as an advisor to the ground unit commander on air force matters. The new organization does provide, however, the teams at the airdromes for use

[13]Air alert mission supporting a ground unit while the unit is in movement.

Personnel and Equipment of Air Support Parties With Corps and Division

CORPS HEADQUARTERS:

Personnel:

1 Lt Colonel — Air Support Party Officer
2 Captain — Assistant Air Support Party Officer
5 Radio operator-mechanics (756)
1 CNS mechanic (759)
2 Truck driver mechanics (014)
1 Communications chief (542)
3 Teletypewriter operators (237)
1 Teletypewriter mechanic (239)

Equipment:

1 SCR-399 Radio (in HO-17 hut for transportation by 2½-ton truck)
1 PE-95 Power Unit (in 1-ton trailer)
1 AN/VRC-1 (Jeep with HF and VHF Radio equipment mounted)
2 Jeeps
3 ¼-ton trailers
2 SCR-624 Radio Sets (a standard SCR-522 aircraft VHF set 100-156 mcs. adapted for ground use with gasoline driven power unit in 1-ton trailer)
2 Teleprinters—TG-7A
1 Switchboard—BD-100
2 PE-75 Power units
2 Fluorescent Yellow Panels AL-141
2 Fluorescent Cerise Panels AL-140

DIVISION HEADQUARTERS:

Personnel:

1 Major—Air Support Party Officer
3 Radio Operator-mechanics (756)
1 CNS mechanic (759)
1 Truck driver mechanic (014)

Equipment:

1 SCR-399 Radio (in HO-17 hut for transportation by 2½-ton truck)
1 PE-95 Power Unit (in 1-ton trailer)
1 SCR-624 Radio Set complete
1 AN/VRC-1 (Jeep with HF and VHF Radio equipment mounted)
1 Jeep
2 ¼-ton trailer
2 Fluorescent Cerise Panels AL-140
2 Fluorescent Yellow Panels AL-141

Table I.

of the GLO's. The important thing to remember is, it removes the function of two-way air ground control of aircraft in flight. This function has been transferred to another newly created team called a tactical air control party[14] which is an integral part of the Air Force control system.

The signal air-ground liaison company,[15] organized under T/O & E 11-547, dated 24 August 1945, is the organization charged with furnishing the point-to-point portion of the facilities once furnished by the tactical air communications squadron. The air-ground operations system is the name that has been gven to the ground force part of air support and the signal company provides the G-2 (Air) and G-3 (Air) of the Army and the army group with the point-to-point communications peculiar to this system.

Each signal company is capable of operating a message center, and 2 teletypewriter stations at the joint operations center (Air Force-Army level or Tactical Air Command-Army group level) and 25 mobile radio stations at corps, division, regional combat team and airdrome level. The company has 7 officers and 227 enlisted men, and is comparable in strength to the former Army Air Forces tactical air communications squadron. As stated above, when assigned to the Army, the signal company installs, maintains and operates the radio communications nets within the Army for the G-3 (Air) and G-2 (Air) at the joint operations center, at each corps headquarters, at each division headquarters and at each regional combat team headquarters if required. In addition, it furnishes the same services between the GLO's at each airdrome and the G-3 (Air) at the joint operations center.

Recent Maneuver Tests

It is the author's belief that this development has created in effect two teams with overlapping functions that now do the work previously performed by one team. The tactical air control party requires air-ground communications as well as point-to-point communications and the air-ground liaison team requires point-to-point communications practically parallelling these. In addition, an Air Force officer (ALO) is now required on the staff of the various ground commanders. It is believed that the concept and methods developed and combat tested in Europe were the more efficient.

During the recent point maneuver, "Tarheel", in the Fort Bragg-Camp Mackall area the 20th Signal Air-Ground Liaison Company, the only company of its kind in the ground forces, had an opportunity to test out its communications teams. The requirements, however, were on such a small scale, that it is felt the training was not overly effective. It is hoped that future maneuvers and exercises will be on a larger scale so that a realistic problem will be presented and a thorough study can be made of the effectiveness of the company's composition and employment as compared to that of the tactical air communications squadron. For those desiring to make a more thorough and detailed study than presented here reference is made to War Department Field Manual 31-25, Air-Ground Operations and Air University Pamphlet No. 36, Tactical Air Operations.

[14]A forward team of the tactical air control group, the group which now contains all the radar control facilities and the air-ground radio channels in an Air Force.

[15]The 20th Signal Air-Ground Liaison Company stationed at Fort Bragg, N. C., is the only such company presently in existence.

ELECTRON TUBE MICROPHONISM INVESTIGATION

By Lester Feinstein
Sylvania Electric Products Inc.
Product Development Laboratories

Information describing the causes of microphonism, which is the electrical noise produced by vibration of tube elements, has become an important aid in tube design for those applications where tubes must be rugged enough to withstand the vibration and shock occurring under such operating conditions as exist in aircraft, guided missiles, automotive vehicles and machinery.

Therefore, in order to develop low-microphonic tubes, it is necessary to understand the features of tube structure that respond microphonically to vibration and shock, and from the knowledge gained attempt to strengthen those elements that are found to contribute to electrical noise. The first step, then, is to study the causes of microphonism.

In conducting such an investigation it is necessary to have a means of imparting controlled motion to the tube and for measuring its electrical response. (Fig. 1). The tube to be tested is mounted on an electromechanical vibrator that is driven by an amplifier whose output frequency is controlled by a signal generator. Power is supplied to the tube through flexible leads, and the signal due to microphonism is developed across a plate load resistor.

Vibration tests of this type are usually run at either constant acceleration or constant velocity throughout the frequency range. A cathetometer is used to check the amplitude of vibration at the desired frequencies. After the amplitude is determined, it is then possible to find the acceleration at which the tube is being vibrated.

When there are a number of tubes of a given type to be tested, a record is made of the necessary voltage to give the desired acceleration or velocity at the test frequencies. In this way the cathetometer need be used only once for each tube type. At high frequencies the amplitudes are extremely small and cannot be measured. However, if the known voltages are plotted, the curve can be extrapolated to get the high-frequency values.

The microphonic signal is then read on a vacuum tube voltmeter and also fed to the plates of an oscilloscope so that the output shape can be observed. A check on the motion of the system is maintained by resting a pickup on the moving pylon. The output of the pick-up is fed to the other set of plates on the oscilloscope.

Under test, a tube is vibrated at discrete frequencies in the range between 25 and 10,000 cycles, and the signal developed at the various frequencies is recorded. By comparing the oscilloscope wave form and the output of the vacuum tube voltmeter, the resonance of the driving system can be distinguished from the resonance of the tube elements.

The tube elements under stroboscopic light are observed through a microscope throughout the test and the moving elements causing the peak output at a given frequency are noted. Peak output signals through the spectrum of vibration frequencies are then recorded along with the moving tube elements that cause these peaks. Examination of the data then indicates structural changes that are necessary for the improvement of tube performance.

Common Causes

Rattle of Elements: In many tubes elements are mounted between micas with a small tab leading to the header pin. This method is generally most conductive to microphonism because of the necessary clearances between the element support rods and mica holes. When attempts are made to decrease the mica hole tolerances, interference fits occur. During tube assembly the mica holes become enlarged because mounters force the elements into the mica holes. In addition, when element motion occurs the mica holes become

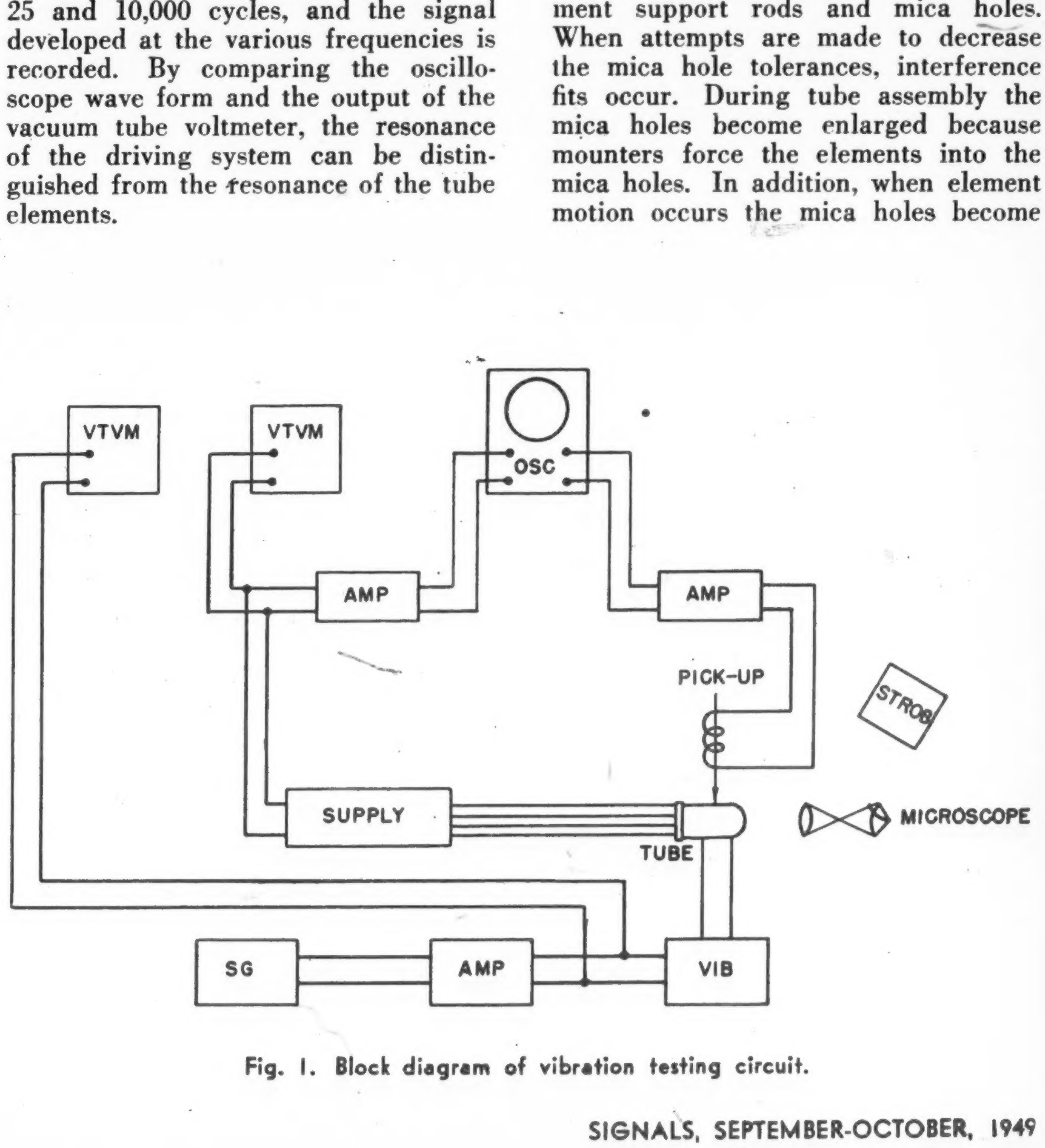


Fig. 1. Block diagram of vibration testing circuit.

enlarged through wear. and the tube becomes progressively more microphonic.

Motion of the Unitary Mount: Tubes are frequently constructed with inadequate mount support on the header and with serrated edges on the micas, which are suposed to press against the envelope. Examination of a number of tubes indicated a clearance between mica points and envelope, allowing motion of the unitary mount. Relative motion between elements and micas resulted in microphonism, and even where the elements were tightly fastened to the mica, impact of the mica striking the envelope caused a vibratory motion of the elements.

Resonance of Elements: Even where elements are rigidly supported, their natural vibration frequencies result in microphonism. These frequencies may be produced by bending, torsion, or a combination of both.

In designing a tube for minimum microphonics the above three features should be considered. The tube should be analysed as a structure and the natural frequencies determined for that structure.

The Rayleigh-Ritz method is adequate for approximating the first bending mode in simple cathode, grid, or plate structures. In more precise calculations the damping properties of the material should also be included. In the Rayleigh-Ritz method it is assumed that the total energy of the system is constant and therefore the maximum kinetic energy is equal to the maximum elastic energy of the system. If a beam is considered, natural frequency of vibration may be expressed as a function of the modulus of elasticity, the moment of inertia, the displacement of the beam, the mass density, and the length of the beam.

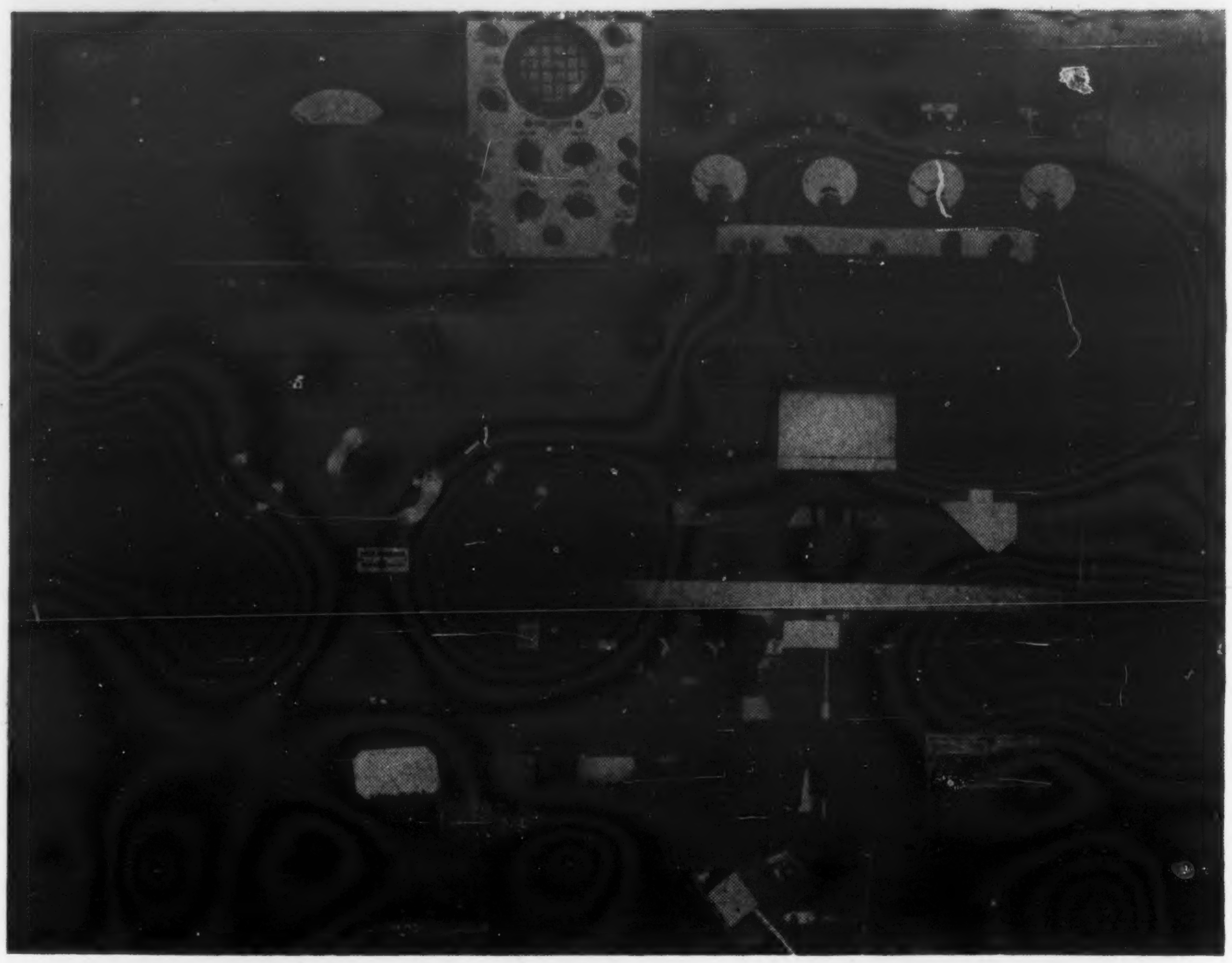


Fig. 2. Complete unit for vibration testing. Loud speaker type vibrating unit is at right in middle section. Tube under test is concealed by steel shelf member.

One of the simplest cases for analysis is a cathode made of circular tubing and supported at the micas by pinching so that there is no clearance. This element may then be considered to be a uniformly loaded beam simply supported at its ends. The uniform loading will include the weight of the tubing, the coating, and the heater. Maximum deflection under static load conditions can then be calculated.

The load in the case of a grid would be the weight of the siderods and the grid laterals. If the grid is supported between the micas like the case of the cathode, the natural frequency will be found by the same procedure. If the side rods are welded to the header pins, the construction is not uniform throughout the length of the beam and analysis becomes more complicated. If the grid is suported only at the header pins the structure becomes a stepped cantilever with a uniform cross section for each of the two parts of its span.

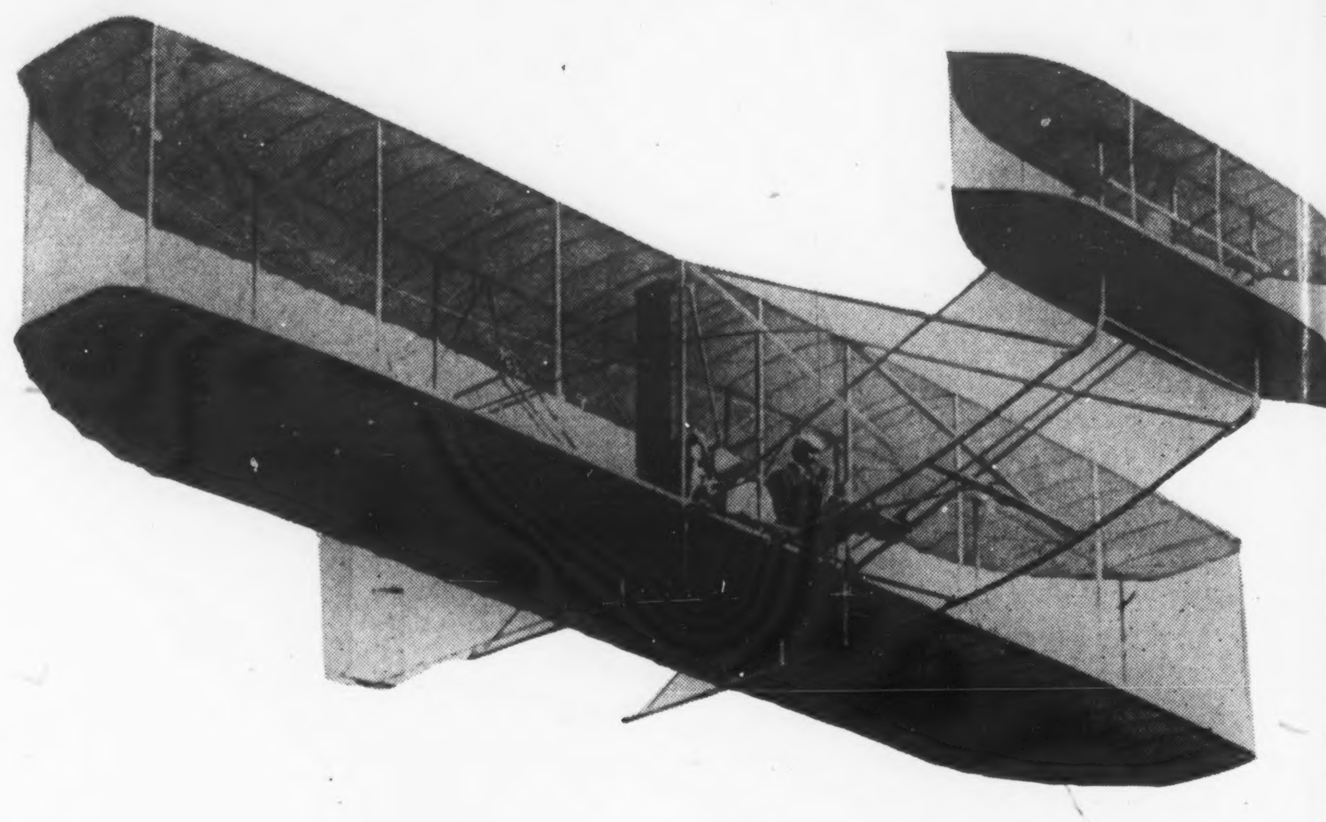
Where there is combined torsion and bending, such as the case of a plate supported by a single side rod, the solution for natural frequency can be obtained from two equations of motion governing the bending-torsion vibrations of an elastic beam. For a unitary mount the type of analysis is similar to the preceding ones, but due care must be given to the end conditions, the method of support, and the distribution of the load.

When there is little damping in the system it is desirable to have the natural frequencies of the elements much higher than the frequencies to which the tube will be subjected.

Fig. 3. Cathetometer mounted on vibrating unit for measuring vibration amplitude.

Conclusion

A method for rigorously testing tubes for microphonism, can be used to indicate the modifications necessary for improving the performance of the tube. The method also shows that the microphonic frequencies of a tube can be predicted. The recommended procedure for designing tubes for a minimum of microphonism is to make the natural frequencies of the elements as high as possible.



Orville Wright in a flight over Fort Myer, Va., circa 1910.

A SIGNAL CORPS VISION OF AIR POWER

Three decades before Pearl Harbor, a Chief Signal Officer foresaw the role of air power in the amphibious war of the Pacific.

In 1913, Brigadier General George P. Scriven suggested that the Committee on Military Affairs of the House of Representatives "consider the island of Corregidor. If an enemy should land, say, at Subig Bay and the defense was provided with aeroplanes, I doubt very much if the attack could get ashore; they must approach with their transports loaded. . .and the beach open to anything that might come over it, attack from overhead —an ideal condition for the dirigible and aeroplane, which by dropping nitrogelatin might stop the landing or at least disorganize the enemy's troops . . ."[1]

The general was asking Congress to leave aviation, then in its swaddling clothes, in the Signal Corps for the development that the immediate future might bring[2] even though he realized that aviation ultimately "may become in truth a fourth arm of the service and demand a large corps."[3]

[1]Hearings before the Committee on Military Affairs, House of Representatives, 63rd Congress, first session, 12-16 August 1913, in connection with H.R. 5304, of 16 May 1913, entitled "An Act to Increase the Efficiency of the Aviation Service of the Army, and for Other Purposes." Pp. 19-20 of the report on the hearings.

[2]*Ibid.*, p. 11.

[3]*Ibid.*, p. 9.

He was testifying on a bill which subsequently created the Aviation Section within the Signal Corps (Public Law 143, passed 18 July 1914).

Prophesy

As he discussed all too prophetically how the air arm might be used in the Philippines, General Scriven suggested that airplanes could be employed to repulse an amphibious attack. Then he gave the Congressmen the other side of the picture:

"On the other hand, if the defense had none (airplanes) and the enemy landed and marched to the hills that overlook Corregidor with a few aeroplanes and certainly with a dirigible, it is difficult to see how it would be possible to hold the position if conditions are at all what they may be expected to be in the attack on this position."[4]

Whereupon the committee chairman asked the Chief Signal Officer:

"Do you mean by that that the science of aviation has advanced to such an extent that any country that is going to war with some other country would be handicapped and at a great disadvantage unless that country had an aviation corps sufficiently experienced to contend with that of the other country?"

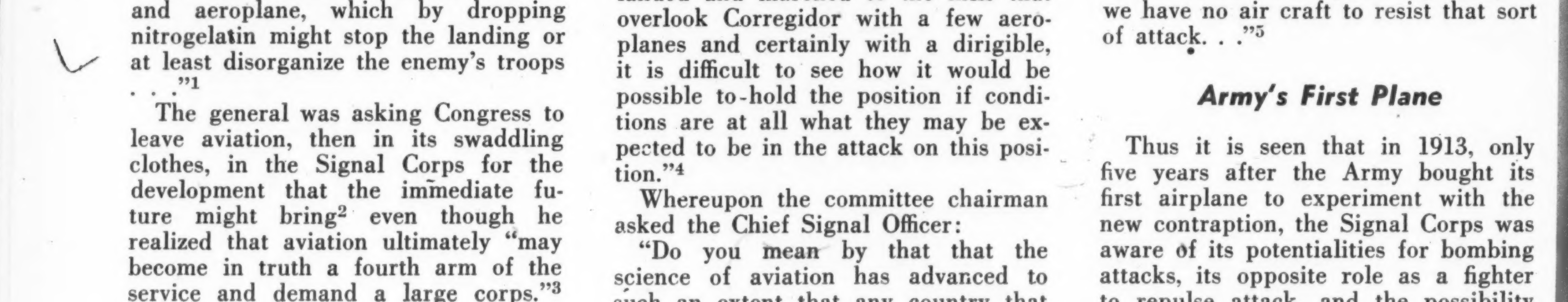
[4]*Ibid.*, pp. 19-20.

Replied General Scriven: "I believe so, most distinctly. If you look at conditions at the Panama Canal. . . Now, the question immediately comes up as to what would be the result of dropping 300 or 400 pounds of nitrogelatin on the lock or spillway. There is probably little difficulty in doing it, and should a foreign fleet (be) anchored beyond the range of the guns of our fortifications . . . aeroplanes may well be sent out and great damage to the canal done. . .if we have nothing to resist the air craft except land guns, it seems more than probable that some damage would be done and the working of the canal interrupted, especially if we have no air craft to resist that sort of attack. . ."[5]

Army's First Plane

Thus it is seen that in 1913, only five years after the Army bought its first airplane to experiment with the new contraption, the Signal Corps was aware of its potentialities for bombing attacks, its opposite role as a fighter to repulse attack, and the possibility of launchings from naval carriers. This foresight was expressed when the farthest any airplane ever had flown was about a thousand miles, and the highest speed obtained was around 125 miles an hour. Indeed, the military

[5]*Ibid.*, p. 20.



requirements for our first airplane had been most modest when it was purchased in 1908 from the Wright Brothers. As he argued to retain aviation a bit longer where it had started and was beginning to take root, General Scriven recalled:

"It has been something like five years only since General Allen, then chief signal officer, bought from the Wright Bros. the first machine, capable of performing the test prescribed; that is, a flight from Fort Myer, five miles out and five miles back. Since then all that has been accomplished has been done by the Signal Corps without assistance and with a total appropriation of $225,000. . ."[6]

Aeronautics Not New

Actually, aeronautics was nothing new to the Signal Corps. During the Civil War, captive balloons were used for observation purposes. Balloons came into the Signal Corps again in 1892. When successful flights were made with airplanes, the Signal Corps explored this invention from the standpoint of using it for reconnaissance and communication—but without losing sight of its potentialities as a weapon, as the 1913 Congressional testimony discloses.

In those early days of aeronautics, when no one knew for sure the potentialities of aviation, it was felt by many that progress could best be made by leaving the infant in the scientific atmosphere of the Signal Corps. The United States Army Signal Corps, General Scriven reminded, was unique among the armies of the world, and he argued that it was in the Signal Corps that our Army had the greatest concentration of scientific minds to study the new problems of aeronautics.

School Established

General Scriven urged "the construction of an Aviation Corps within the Signal Corps" and he asked for the necessary authority and funds.[7] He asked for establishment of an aviation school, after pointing out that the location was very important. The Atlantic Coast was undesirable because of wind velocities; the North was bad because planes could not be flown during the winter, when an aviator became stiff from cold and could not handle his delicate craft. General Scriven recommended Fort Sam Houston, San Antonio, Texas, near the site of Randolph Field.[8] He asked for the provision of sufficient rank to push along with aviation. The bill under discussion provided that a major head the Aviation Section. General Scriven objected that "a major is not sufficient to handle this proposition. It has come

[6] *Ibid.*, p. 9.
[7] *Ibid.*, pp. 11-12.
[8] *Ibid.*, p. 14.

The Wright brothers, Orville and Wilbur, and between them Lt. Ben Foulois, later Maj. Gen. Foulois, chief of the Air Corps.

to be a very big question, and you should have at least a colonel at the head. . ."[9]

Future Leaders Testify

Men who one day were to be prominent in American military aviation testified along the same lines at the 1913 hearing. There was, for example, Lieutenant Benjamin D. Foulois—later to be Major General Foulois, chief of the Air Corps—arguing for retention of aviation in the Signal Corps. He told Congress:

"We have just gotten to the point, I think, where we are beginning to learn something about aviation; we have not yet gotten to the point where we know what our organization ought to be—whether it ought to be a separate corps or left as it is. It looks to me like swapping horses in the middle of a stream. Why can we not wait until we have some evidence upon which to build a fixed organization? . . .Personally it does not make any difference to me whether it stays in the Signal Corps or goes to the Quartermaster Corps, the Nurses' Corps, or any other corps. What we want is this: We want the best men we can get, and the best men we have right now are in the Signal Corps, where the work has been done for the last five years and where all aeronautic work has been done for the last 20 years."[10]

Lieutenant Foulois said later that he thought eventually aviation ought to be a part of the line of the Army, but no one then knew when that would be.[11] He added that "I think if we had gone in hastily a few years ago with a million dollars we would not have known what to do with it."[12]

Even Captain William Mitchell, of the United States Signal Corps, in that day was skeptical about the value of the airplane. He said:

"Now, the offensive value of this thing has not been proved. It is being experimented with—bomb dropping and machines carrying guns are being experimented with—but there is nothing to it so far except in an experimental way."[13] He said he thought it would be a mistake to start a separate corps[14] and anyway, if a large number of aviators went into the Signal Corps, it was possible that aviation some day would be running the Signal Corps.[15]

Lieutenant H. H. Arnold also expressed the opinion that until aviation "becomes able to take care of itself, I think it would be far better with the Signal Corps. At the present time it is not able to take care of itself."[16]

In that day, aviation not only was in its infancy, but the men who were to guide it to maturity knew so. The environment of growth was the Signal Corps, where a tradition of experimentation was set by its founder, Dr. Albert J. Myer. Aviation has grown in importance beyond the dreams of any of the men who discussed it in a committee room of Congress back in the summer of 1913. It has grown from the vision of Signal Corpsmen, who in 1908 thought they'd see what they could do with the Wright brothers' gadget, and by 1913 were able to paint an all-too-distinct picture of World War II.

[9] *Ibid.*, p. 11.
[10] *Ibid.*, pp. 50-51.
[11] *Ibid.*, p. 54.
[12] *Ibid.*, p. 55.
[13] *Ibid.*, p. 77.
[14] *Ibid.*, p. 83.
[15] *Ibid.*, pp. 83-85.
[16] *Ibid.*, p. 92.

RADIO POINT LOMA

Decommissioned in June the Navy's radio station at Point Loma, California, has an eventful history beginning with the early wireless days. Its activities have figured prominently in the development of radio.

Decommissioning ceremonies, Point Loma.

After nearly a half-century of operation, the Navy's historic radio station at Point Loma (California) was decommissioned June 24th during ceremonies which also included the breaking of the earth for a new building at the Navy Electronics Laboratory. (News item, SIGNALS, July-August 1949).

The history of Point Loma is a narrative of the development of Naval communications, for this pioneer station participated in the evolution of our modern equipment and procedure. Civilian research gave birth to wireless telegraphy and voice transmission over the airwaves, but the development of equipment was largely handled by the military. Commercial entertainment radio as we know it now did not then exist, radio being used solely for the purpose of communications.

In 1905 a party from district headquarters, Goat Island, San Francisco, made the survey for a radio station to be located on the tip of Point Loma. The original installation was made by chief electrician R. B. Stuart, now principal civilian assistant to the electronics officer, Navy shipyard, Long Beach. The station was commissioned 12 May 1916. Working a Massie type transmitter, R. W. Moore, electrician 2nd class, was designated radioman-in-charge.

It was a long trek by wagon from San Diego to the station in the early days. In order to supply the installation during the construction period, and later, it was necessary to follow a road through the tule swamp which is now the site of the Navy training center. When the river was in flood stage no wagons got through and the men lived meagerly.

In 1909 President Theodore Roosevelt sent the Great White Fleet to show the flag in the seaports of the world. When they visited San Diego, a marvelous new development in the field of radio was tried with Radio Point Loma participating. Doctor Lee DeForest, whose vacuum tube made possible his development of the wireless telephone, was aboard the USS *Connecticut*. One of the first successful tests of voice transmission was made between the ship and Point Loma.

Acquires Call Letters

In 1912 radio communications had progressed to a point where Federal control of traffic became necessary. The former two letter call signs of broadcasting stations were changed to three letter calls, all Navy stations taking the designator N. Thus Radio NPL at Point Loma came into existence. The continued use of its call letters from that day to this has perpetuated the memory of the historic station.

A number of the early investigations on atmospheric interference, its source and cause, were conducted at Point Loma by Dr. Louis W. Austin, head of the U. S. Naval radiotelegraphic laboratory at the Bureau of Standards from 1908 to 1923.

As the range of radio broadcasting became greater, it was found that the link stations up the coast became superflous; Point Loma, Mare Island and North Head on the Columbia River became more important as the intervening stations were reduced to the status of compass stations.

Aided Industries

Communications with our nationals in private industry in Mexico became a problem of paramount importance. It was the era of tremendous financial boom below the border. In order to keep in touch with American business enterprises in Mexico a complicated radio network was set up starting with Radio Point Loma, who then worked the flag-ship of the fleet stationed at Guaymas in the Gulf of California. She was the USS *California*, a four-stacker armored cruiser, and she in turn communicated with radiomen employed at fabulous salaries by the mines and sugar companies in wild outposts of Central America. Thus the station aided in the progress of industrial relations with our neighbors below the border.

In 1915 new equipment came to Radio Point Loma. A 500 cycle German

Telefunken type transmitter was installed as well as a Danish Poulsen type of 30KWs. The new arc type installations were gas fed. The flame worked much the same as the old gaslight era street lights. In certain civilian stations the light was fed by alcohol. This fuel was deemed impractical by the Navy. Consequently the personnel at Radio Point Loma kept efficiently sober.

Hams Picked Up News

All of the news events of the period were broadcast to the fleet via the facilities of Point Loma. History-making accounts such as the assassination at Sarajevo were picked up by amateurs who tinkered with crystal sets, so the station was known and worked by the early enthusiasts who later became the leaders of the radio industry.

Near-neighbor of the radio station on the point was the Theosophical Society presided over by Mme. Tingley. This lady welcomed the naval establishment and did much for their welfare, though sometimes inadvertently. Particularly succulent turkeys were raised by the society, and at times temptation to augment Navy fare may have led to the organizing of foraging parties. It is not known definitely whether or not anyone succumbed to this temptation, but complaints addressed to Capt. J. A. Ashley, district communications supervisor, indicated such a possibility. Mme. Tingley also wrote to him on the score of disturbance to the meditations of her flock caused by the practice firing by the fleet on maneuvers. However, she was a motherly soul and her many kindnesses indicated that she held no grudge. Shrubs used to landscape the grounds were contributed by this generous lady.

When Capt. Ashley arrived in San Diego, the Navy's entire shore establishment was administered by only three officers, Lieut. E. A. Swanson for recruiting, Comdr. J. C. Thompson, a doctor, and a boatswain in charge of the coal pile at La Playa. Capt. Ashley made the fourth, though not for bridge, he states.

Lt. Comdr. Glenn Twiss headed the Point Loma establishment from approximately 1914 to the outbreak of World War I. He built and installed a receiving set using the then-revolutionary vacuum tubes. This set was evolved from experience gained by Mr. Twiss in the making of his first set for the old cruiser *San Diego* (Previously named *California*) which was used by that ship until the time of her sinking off New York.

San Diego Flood Aid

Comdr. Twiss tells how Radio Point Loma served the city of San Diego during the 1916 flood. This is a familiar tale to the old-timers of the city, but it bears repeating to include the part played by the radio station. When Hatfield the Rainmaker was offered $10,000.00 to relieve a long-enduring drought, the rockets he fired and the passes he made at the empty blue skies resulted in a downpour unrivaled in the annals of the weather bureau. When the reservoir was filled the city council decided that enough was enough, but the heavens continued to pour. It was decided that Hatfield, like the Sorcerer's Apprentice, had let things get out of hand. When the Otai Dam burst the city fathers were so incensed that Hatfield was content to forget the $10,000 and get out of town. That proved to be a difficult thing to do, for the roads were washed out, the Santa Fe hadn't a track to its name and all communications were disrupted. For some, however, there was consolation. A winery was demolished and its casks were washed into the bay. Fishing suddenly became a popular pastime in spite of inclement weather. The news of the disaster had to get out, but exactly how was a question. Western Union wasn't doing too well. It didn't close up shop, but the slow boats to Los Angeles employed by the company gave impetus to contemporary cartoons depicting bearded messengers getting the traffic out at a snail's pace. Representatives of the press went to Radio Point Loma and requested use of the station's facilities. Permission was granted, and the story of isolated San Diego's disaster went to the outer world at the rate of 5,000 words a day. The Navy was credited with rendering a public service. Their stipulation that every news story had to carry the byline "via Radio Point Loma" assured public recognition of the fact that the U. S. Navy was on the job in spite of wind and high water.

During World War I Point Loma became a busy and vital link in military communications. It served patiently and efficiently.

Post WW I Growth

After the war the Pacific Fleet came to San Diego in numbers, increasing the demands made on the facilities of the radio station. Point Loma grew to accommodate the new volume of traffic. In 1919 directional reception was installed at the station and another advance in efficiency was made. In the 1920's Point Loma became the first station on the coast to handle transcontinental traffic. Admiral S. C. Hooper came west to inaugurate the service. Adm. Hooper had been an enthusiastic worker of Radio Point Loma as a radio amateur in the crystal-set era. Radio "hams," as these amateurs were called, spent happy evenings trying for distance in reception, enjoying a hobby that kept earphones glued to their heads. So Admiral Hooper had a sentimental attachment for the Pacific Coast station derived from long hours of listening to its early broadcasts. He insisted on tapping out the first transcontinental message to leave Point Loma.

And so the station carried on uneventfully but faithfully. In 1940 the new Navy electronics laboratory came into being as a facility for housing the research program which resulted in the miraculous developments that played such a part in the winning of World War II. The laboratory was built on ground adjoining the radio station.

Pearl Harbor

December 7, 1941. History was made in the Pacific and Point Loma entered this first day of the war in a major role. During the enemy raid on Pearl Harbor there were many casualties to communication control lines from the Navy Yard to the receiving and transmitting stations. The high power transmitting station was under attack and for a time doubt was created as to its ability to keep on the air. Radio Point Loma stepped into the breach and for 60 hours served the entire Pacific Fleet by radio link from the headquarters of the Commander-in-Chief of the Pacific Fleet.

Point Loma continued to serve through another war and the years that followed. The history of the station is an honorable one. Its personnel can be proud of the record. No longer essential as a shore establishment, the historic installation has now been absorbed physically by the ever-expanding Navy Electronics Laboratory. A new laboratory building is to be constructed and the old station is being decommissioned to make way for progress.

Radio Point Loma Retired

After nearly a half-century of operation, the Navy's historic radio station at Point Loma was decommissioned June 24th during ceremonies which also included the breaking of the earth for a new building at the Navy Electronics Laboratory.

The project calls for a two-story front structure overlooking San Diego harbor, 650 feet by 50 feet, backed by five wings, each 194 feet by 140 feet. The total gross floor area will be in excess of 183,000 square feet.

The physical identity of Radio Point Loma will not be lost in the rush of new laboratory construction. Rather the physical assets of the communications center will be incorporated into the overall plans of the research building program. The main radio station building, for example, from which point the Navy communicated with the Pacific Fleet during the Pearl Harbor emergency, is being remodelled to do a new job. It is being converted into a modern sound recording laboratory for continuing investigations in radio and sonar.

Antenna, AN/TPS 10, at the Gordon school.

AIR FORCE SCHOOL

For Communications—Electronics—Staff Officers

By Col. Harold W. Grant

In keeping with the tremendous rise in importance of electronics as both an offensive and defensive weapon, a new top level school commenced operations on 17 January 1949 at Gunter AF Base, Ala. Its first class was graduated in June. The school has as its mission the education of senior communication and electronic officers for staff and planning duties at wing and higher levels, as well as for command of communication and electronic units.

Called the *air communication and electronic staff officers' course*, the school requires 22 weeks and is conducted by officers and airmen of the communication and electronic division of the Air University's special staff school. Colonel Harold W. Grant is director of the division.

Students are carefully selected graduates of the Air Command and Staff School who are senior officers in the communication and electronic field. In order to cover all phases of instruction believed necessary to produce a highly competent communication and electronic staff officer, the academic staff has been divided into four sections: logistics, management, engineering, and operations. In addition to those officers on the permanent faculty, guest lecturers, both military and civilian who are experts in their field are presented.

Since the number of field grade communication officers who have graduated from the Air Command and Staff School is limited, provisions have been made for selected officers to attend that school immediately prior to the air communication and electronic staff officers' course.

The Air Command and Staff School is designed to develop skills and techniques and shape thought on future air power for the field grade Air Force officer, regardless of his primary military specialty. Emphasis is placed on organization and employment of large Air Force units and on the organization, characteristics and employment of the Army and Navy. Considerable instruction is devoted to a critical examination of current equipment, techniques and accepted standards, and to the logistics of Air Force operations.

The scope of instruction at the air communication and electronic staff officers' course is broad, building upon knowledge gained at the Air Command and Staff School. Students are taught to strive for maximum exploitation of electronic devices and techniques in conjunction with overall planning for both Air Force and joint air operations. In conformance with the mission of the school, much instruction is accomplished through the mediums of conferences, seminars and actual problem solving. In all of these maximum emphasis is placed on student participation in order to achieve the greatest possible interchange of background knowledge among students.

Field Trips

At least one major field trip is scheduled for each course on which students are flown to key centers of communication and electronic activity. A typical trip would be of one week duration and include visits to Air Materiel Command research and development activities and to the Directorate of Communication, USAF.

Several one day trips are also scheduled during each course. These trips are designed to better acquaint students with equipment and systems in operation, thus enhancing the value of formal platform presentations.

Facilities at the school include representative pieces of all major communication and electronic equipment presently in use by the Air Force, a well stocked library, and newly constructed class and seminar rooms.

For the story of the growing need for this type of school and officer, we must go back to the pre-World War II period when Air Corps communication and electronic requirements consisted principally of telephone and teletypewriter services and a limited amount of air-ground communications. During this period the Air Corps depended largely upon the Signal Corps to provide most of these services. In addition, there was a small number of rated Air Corps officers whose primary duties, as communication officers, were to provide for the operation and maintenance of air-ground communication circuits and associated equipment.

These few officers, however, were also responsible for operating and maintaining the post telephone and telegraph systems as well as for the local supply of signal equipment. Hence, because the communication activities of the Air Corps communication officers were thus limited, while the design, procurement, and installation of equipment was the responsibility of the Signal Corps, communication staff work and planning was practically nonexistent in the Air Corps.

Staff Officer Need

With the expansion of the Air Corps during the mobilization period preceding the war and the resultant need for greater communication facilities, the requirement for communication and electronic staff officers at the wing and higher levels became increasingly evident. But because of its limited experience along these lines, the Air Corps attempted to adapt to its structure the existing Army communication concepts and organization. This resulted in the authorization and assignment of many Signal Corps officers to major Air Corps units. The requirement still existed, though, for operating and maintaining communication and electronic equipment for air operations; therefore Air Corps communication officers were added to the staffs, generally as deputies to the Signal Corps officers.

Although the emphasis at this time was, in general, largely on ground point-to-point communications, the experience of the British during their first two years of war clearly revealed to the Air Corps the greatly increased requirement for communications and electronics in the conduct of air operations. This requirement, in turn, indicated the need for greater numbers of better-trained communication and electronic officers.

To meet this need the training command expanded and accelerated its program and larger quotas of Signal Corps officers were assigned to the Air Corps for duty. Meanwhile, although not formally trained for such duties, the small number of Air Corps officers who had been working in communications for some time were the only personnel

available for assignment to staff work and planning positions which required a knowledge of the application of communications and electronics to air operations.

Despite the vast expansion of the Signal Corps following Pearl Harbor, the pressure of the Army Ground Forces' operational requirements necessitated a decrease in the percentage of personnel available for assignement to the Air Corps. Consequently, the Air Corps was compelled to augment its supply of communication and electronic personnel principally through commissioning civilians and non-commissioned officers with technical backgrounds, as well as through the aviation cadet program, the officer candidate schools and other procurement sources. The training given these officers was intensive, preponderantly practical, and narrowly specialized; but not one course of instruction was offered in communication and electronic staff work and planning even though the need for such instruction was becoming more urgent each day.

Meanwhile, the error made by the Air Corps several years before in adopting the Army communication concepts and organization, instead of clearly thinking through this problem and developing a concept and organization properly tailored to its own particular needs, became more evident and more alarming. The most serious, perhaps, of its many defects was the divided responsibility for communication and electronics: Signal Corps personnel were largely responsible for point-to-point communication and ground radar; Air Corps personnel, for air-ground communication and airborne radar.

Early Errors Seen

Too frequently, resulting from a lack of understanding on the part of one for the role of the other, there was dissension and lack of cooperation. It is understandable, of course, how this error occurred, since so few Air Corps officers had the training and background to envision the scope and significance of communications and electronics in aerial warfare. As the war progressed, however, and communications and electronics became dominant factors in the planning and execution of air operations, the seriousness of the original error became more widely appreciated throughout the Air Forces, particularly by those who were closely associated with the conduct of the air war.

Many field commanders recognized the need for immediate and on-the-spot corrective action. Accordingly, they reorganized their communication staffs and formed various communication and electronic provisional units especially designed to fulfill the needs of their particular commands. Out of this confusing patchwork of expediency emerged the first real air communication and electronic staff officers. They

Antenna, AN/TRC-6 left, and AN/TRC-5 right, at Gordon.

appeared toward the end of the war not as a result of directives from higher headquarters nor from any formal training and preparation they had received. Rather, they were officers—both Air Corps and Signal Corps—who had, through experience, acquired a broad and sympathetic understanding of the overall air communication and electronic problem.

Thus, as the war ended, the Air Corps had a few officers who could be considered competent air communication and electronic staff officers. Most of them, however, were staff officers only for a particular type of unit or operation since they had had no opportunity to become familiar with the communication and electronic aspects of commands other than their own. The Air Corps had developed no overall communication doctrine, therefore it had been necessary for the various commands to develop doctrines which were peculiar to their structures and operating conditions. Few of these doctrines were similar then, and even today there is considerable difference in command communication doctrines.

In the demobilization which followed the war, many thousands of communication and electronic officers were separated. Among these was the majority of the air communication and electronic staff officers referred to above. Consequently, there are at present very few officers in the USAF who are qualified for air communication and electronic staff work and planning on the wing and higher levels of command.

This situation in itself would normally be serious enough. But Air Force autonomy and expansion have greatly increased the requirement for this type of officer. The present situation, therefore, is not only serious; it is extremely critical.

There has been no school in the USAF system of training and education —which includes the Air Training Command, The Air University, and the civilian educational institutions attended by USAF officers—that has offered high-level instruction of the type required to produce the air communication and electronic staff officers so desperately needed by the Air Force.

The school which opened on 17 January 1949 at Gunter AF Base is designed to rectify this situation and meet this pressing need.

It is the goal of the school to produce an officer capable of advising his commander on all matters pertaining to the most effective use of the latest communication and electronic devices and techniques and assisting his commander in the development of plans for both Air Force and joint air operations so that maximum exploitation of these devices and techniques may be achieved. He must also be able to supervise all stages of communication and electronic preparation for its role in air operations, and to participate in communications policy and planning conferences and committees as a representative of his commander or of the USAF, regardless of whether these conferences and committees be intra-Air Force, joint services, or international in character.

Personal Requirements

The ability to do these things requires that the air communication and electronic staff officer possess certain characteristics. He must, first of all, have a broad knowledge of Air Force command and staff functions, relationships, and procedures. This is essential because communication and electronics are playing an increasingly significant role in air operations, and because there is practically no phase of Air Force activity which does not involve communications and electronics.

He must also be sufficiently familiar with the capabilities and limitations of all kinds of conventional communication and electronic equipment so that he can make maximum use not only of the equipment but also of the skilled technicians under his supervision.

Further, he must have a thorough knowledge of communication doctrines, policies and principles; and he must also possess the ability to plan and supervise the operation, maintenance and installation of conventional communication and electronic systems. Finally, he must have a keen awareness of various fields of endeavor in which the exploitation of air communications and electronics can make a significant contribution to the successful waging of war. As previously stated, courses for developing these latter characteristics have not been available in any school in the USAF. For that reason the provision for this instruction becomes not only the responsibility of the Air Communication and Electronic Staff Officers' Course but, in a broad sense, the very mission of that course.

ELECTRONICS IN AIR WAR

By Colonel Wendell W. Bowman
U. S. Air Force

Our national objectives and the military strategy stemming from them are a matter of speculation for those outside the inner circle. One important point, however, appears to be fairly well settled and generally, though reluctantly, conceded—air power has emerged as the decisive weapon in modern war.

It is logical to assume that in conceding to air power the dominant role in future wars, its maximum potential capabilities are envisaged. The air power of a nation is composed of a multiplicity of factors, culminating in military air operations, the cutting edge. Military and political officials who think and talk of air power as the decisive weapon in future wars are undoubtedly measuring it in terms of potential firepower. To deliver firepower by air, or to exploit the air space for the purpose of waging war, requires air operations, which in turn involves the employment of aircraft in flight.

Piloted Plane Still Basic

For the foreseeable future piloted aircraft will continue to be the basic unit of military air power. Obviously, to be effective aircraft must fly. An airplane on the ground is an expensive, vulnerable, and totally useless object. Successful and sustained operations are dependent upon the ability to fly when and where required and to accomplish the assigned mission at a tolerable cost.

There is little question but that we must defeat the weather before we can defeat the enemy. To be effective an air force must first attain all-weather operating capability. Adverse weather conditions, particularly poor visibility, constitute the greatest of all limitations upon effective air operations. Range, speed, and service ceiling are inherent characteristics of aircraft designed for specific functions and can be attained to a satisfactory degree. However, these most necessary characteristics do not within themselves insure the end result—application of firepower against the vitals of the enemy war potential.

An effective air force must be able to take off, navigate to the target area, penetrate defenses, identify and accurately bomb the objective, and return to base and land, regardless of weather conditions. In fact, it may be desirable to use weather and darkness as a cover to reduce combat losses. Defensive air operations must be on an all-weather basis, since the enemy has the initiative and can select the time and place and conditions most favorable to his attack. The USAF has made great strides in all-weather operations but some problems remain only partially solved. Technology can produce the ancillary devices required to insure accurate and certain delivery of these weapons to the industrial heartland of any future enemy.

Electronics, The Tool

Electronics is the tool for the job; modern science has suggested no alternate. The principal limitations imposed by weather, high altitude, and darkness are occasioned by the inability of the human eye to see under such conditions. Electronics, specifically radar, is a fairly efficient substitute for human vision. During the last war the need to compensate for human limitations became apparent and resulted in frantic efforts to develop equipment for the purpose. Only partial success was achieved, but it was sufficient to give us some measure of qualitative superiority over our enemies and to permit air operations under conditions previously thought impractical. Without exception these developments were in the field of electronics.

In general the functions and types of missions the Air Force will be expected to perform in the next war are: strategic bombardment, air defense, tactical air support, air transport, and troop carrier. The priority of these missions and the relative emphasis that will be given to each in the initial and subsequent phases of the war are irrelevant to this discussion. In order to gain an understanding of the factors involved in the execution of the various types of air missions, each will be analyzed in some detail with particular attention focused upon the role of electronics.

Strategic air operations form the substance of modern military air power. They will be the most decisive, difficult, and costly, yet our national security turns upon their success. In order to analyze realistically the strategic mission, it is necessary to assume a reasonable hypothesis: the U. S. is opposing an industrially powerful enemy; the strategic target system is the enemy industrial heartland; initial air operations will be conducted from present bases.

Strategic air power is a term that has caused considerable talk, and some thinking, both in and out of military circles. It is held in some quarters that our ability to bring strategic air power to bear upon potential aggressors constitutes the principal, if not the sole deterrent to war. We hear and read such statements as those about "immediate retaliatory air attacks of such devastating effect that no aggressor nation will dare to attack." People who think in such terms are imagining the end result, that is, delivering mass destruction firepower on key targets, without considering all the means to that end. The problem of destroying a selected target system is composed of many elements, each of which must be satisfactorily solved if the mission is to succeed.

May Air Refuel on Mission

First there is the aircraft itself. We must have strategic bombers designed in terms of range, speed, and pay load for the job operating from available bases. It appears that we have such aircraft, along with highly trained crews to man them. The problem that remains is to employ these aircraft effectively and economically on operational missions. A mission consists of taking off, possibly refueling in the air, navigating to the target area, penetrating enemy defenses, identifying the specific target, bombing with extreme accuracy, returning to base, and landing.

The above functions must be performed accurately irrespective of weather conditions. Can we do these things today? The answer is, we can, with varying degrees of efficiency, due primarily to modern electronic devices. In this technological age electronics has emerged as an indispensable element in the effective employment of military aircraft. To illustrate this point, a somewhat detailed analysis of the part played by electronics in a long-range strategic air mission is in order.

Night Refuel by Radar

The take-off and climb to initial cruising altitude require no particular assistance from electronic devices other than normal two-way radio phone communications. Assembly into desired formations, however, is facilitated by radar, especially at night and during bad weather conditions. The problem of navigating to the target area, either directly or circuitously, over great stretches of water, arctic wastelands, or inadequately charted enemy territory is primarily solved by the use of ground-installed and airborne naviga-

Courtesy of Air University Quarterly.

tional devices. The usefulness of celestial navigation, both manual and automatic, should not be discounted.

However, it must be actively borne in mind that the ability to see celestial bodies is a prerequisite to its use. Positive assurance that such ability will prevail throughout the flight, from take-off to bomb release point, cannot be given unless we elect to conduct all missions at maximum altitude. In the interest of precise and accurate delivery of mass destruction weapons, lower level penetration and bombing runs may be required. At present and for the foreseeable future electronics provides the only positive and reliable means of navigating to the assigned target under all circumstances.

As for air refueling, the rendezvous between the tanker and bomb carrier is rendered possible by air-to-air homing, radar, or automatic direction finding. The final positioning for transfer operations under conditions of restricted visibility or at night may be made possible by the use of radar.

Electronics is the tool, science has suggested no alternative.

Counter Measures

The penetration of enemy defenses, assuming they are formidable, will require our greatest efforts. The absolute necessity for delivering a very large percentage of our mass destruction weapons adds emphasis to this problem and impetus to its solution. Air defenses are designed to shoot down attacking aircraft by fire from the ground or from fighter aircraft. In either case success depends upon highly effective electronic fire control systems.

In turn, successful penetration depends to a high degree upon effectively neutralizing these control systems by airborne jamming devices. Electronic counter-measures can be developed and employed to jam enemy fire control systems, ground controlled intercept radar, air intercept radar, and radar sighting. The value of conventional defensive armament against high-speed fighters at high altitudes, at night or in the clouds, is questionable. Any success achieved will be dependent upon electronic detection and sighting devices.

Radar Target Identification

The identification and bombing of the assigned target is the pay-off. If we cannot accurately bomb the specific target the mission is a failure. If we lack that capability we lack true air power and thus the ability to effectively wage modern war. Optical bombsights have an obvious and definite limitation inherent in all optical instruments including the human eye; one must see the target, and the use of electronics in the form of radar bombing equipment provides the only means. The present radar bombing equipment and techniques are not completely satisfactory, but they can and will be improved.

Navigation back to the base is substantially the same as on the base to target flight. However, there is considerable difference between being twenty or thirty thousand feet over the home air base and being on the runway. Thick overcast and low or zero ceiling conditions, coupled with high traffic density, constitute a problem in traffic control and landing that awaits an adequate solution. Complications arise if the reserve fuel supply is low, as it well may be after a strategic mission from present bases.

All Weather Control

The traffic control and landing system must handle traffic safely and expeditiously under all weather conditions. The only factor limiting the landing rate that can be tolerated is the acceptance rate of the runway. Without going into the functions of the system components it can be stated categorically that they are one hundred per cent electronic. The system can be established using existing and immediately procurable equipment plus a few items now in the final stages of development.

In strategic air operations the role of electronics clearly spells the difference between success and failure. If air power is to be our decisive weapon, then there can be no failure in the strategic air effort.

If we give the initiative to the enemy it must be assumed that he will strike only after carefully weighing his relative capabilities. Logically the first blow will be aimed at our most vital industrial facilities and strategic striking forces. This blow must be blocked, or at least reduced in force.

Air defense cannot win a war but lack of it can certainly lose one. Truly effective air defense against a capable and determined enemy appears, at the moment, to be an almost hopeless task when measured in terms of our current and projected capabilities and economic capacity. Be that as it may, and assuming that we will have an air defense system of a sort, let us examine the part played by electronics and communications.

Early Warning Net

Current thinking on the problem points toward an early-warning radar screen with the maximum depth and coverage economically obtainable. The individual early-warning radar stations must be tied into a net, which in turn will be connected by instantaneous and reliable radio communications links to filter and control centers. Interceptor aircraft will of necessity come under ground controlled intercept radar during a large portion of their intercept mission, at least until they come into range of air intercept radar. Then to effect a kill, using guns or rocket missiles, at high altitudes or during low visibility conditions, gun laying must be by radar. The safe return to base is accomplished by electronic navigation traffic control and landing devices.

This latter problem is particularly difficult for fighters during darkness and adverse weather conditions. The enemy can be expected to exploit any deficiencies in our all-weather fighter operating capabilities. The electronic devices and communications network incorporated in an air defense system do not within themselves constitute air defense. However, they are the means by which air defense is achieved and are indispensable to its effectiveness.

In an active air defense system the problem of positive identification is most difficult. Automatic electronic transpondors appear to be the only

possible solution. A completely satisfactory IFF system is yet to be developed; however, research and development should produce a simple and secure electronic device in the near future.

Tactical air operations, including cooperation with ground forces, are probably more dependent for success upon strict control and coordination than any of the other types of air missions. Even in good weather and visibility the pilot of a low-flying, high-speed aircraft is generally not able to visually detect and identify specific targets successfully without assistance from ground control. As the visibility decreases this dependence increases rapidly to a point where complete electronic control is necessary.

All Weather Operation

Tactical control radar, with the associated communications net and control centers, plus airborne radar and electronic sighting devices, comprise the means for successful and sustained tactical air operations. In other words, electronics assure effective all-weather tactical operations, including safe and expeditious landing. The Battle of the Bulge is a classic example of impotency when all-weather operating capability is lacking.

The air transport problem, though somewhat simpler and generally less vital than combat operations, remains only partially solved. The best of our commercial airlines are able to maintain schedules only to a degree. In all fairness, however, it should be understood that safety considerations and regulations are primarily responsible for this. In the interest of obtaining maximum utilization of our *inadequate* transport fleet it is necessary to assume that transport operations will be on a strict schedule basis. Only weather conditions, such as turbulence and icing, which the aircraft cannot structurally surmount should be allowed to limit the maintenance of schedules.

Current Problems

The specific problems involved are navigation, traffic control (both en route and terminal area), and expeditious landing. Existing or procurable electronic navigational aids, ground installed and airborne, provide a satisfactory solution to the navigation problem. The terminal area traffic control and landing problem is only partially solved using existing electronics systems. Current developments in the field of electronics promise to provide the solution in the very near future. No alternate system based upon other principles is envisaged or appears likely to emerge from present technological trends.

Troop carrier operations can be divided into two fairly distinct categories in so far as electronics is concerned: first, airborne or parachute troops with limited initial equipment; and second, air transportable units of the ground force with full organizational equipment. This latter operation is quite similar to scheduled air transport in that relatively fixed air routes are used, including permanent or semipermanent installations of navigational and communications facilities.

Transport Traffic

The one important difference is the necessity for moving extremely large tonnages of men and equipment in the shortest possible time. This requirement is not always present, however, although situations will no doubt arise where it is. We must be prepared to handle large fleets of transport aircraft in terminal areas and do it safely and rapidly. Assuming situations where ground troops must be air transported even though terminal area weather conditions are extremely unfavorable, a premium is placed on the electronic traffic control and landing system. A fully automatic electronic system is required because a manual control system is quickly saturated and falls apart in confusion.

To air drop troops, or land them by gliders, imposes some peculiar problems that can be solved only by electronic devices. Designated drop areas are invariably critical in terms of their boundaries. Troops and equipment scattered over the countryside, or dropped in the wrong area, are usually ineffective and are largely sacrificed. The problem is to drop them at the right place at the proper time. To achieve security and surprise will generally require that drops be accomplished at night and perhaps during bad weather.

To pin-point selected areas, positive and accurate navigational aids are required. Airborne radar used in conjunction with droppable radar beacons is a possible method. Improved methods may be worked out and equipment developed to implement them, but within the bounds of present technology, the electronics principle will be employed.

Centralizer Control

A strategic air war using bombs or other weapons of mass destruction will require centralized control from the top echelon to insure maximum coordination of effort and effectiveness. Combat missions conducted from our available bases in coordinated simultaneous strikes, or on predetermined schedules, will be possible only to the extent that rapid and reliable command communications channels permit. The exact command structure and the degree of operational control that will be exercised is not known, nor is it particularly relevant to this study.

Suffice it to say that radio communications will provide the means. Air Force headquarters, the strategic air command, operational air forces and their echelons, and intermediate and forward bases will of necessity be linked by a command communications net. This net must be the exclusive tool of the Air Force chief of staff. In addition there must be a global system of powerful air-ground radio stations to insure instant and reliable contact with aircraft in flight any place within the Northern Hemisphere. The systematic destruction of the enemy war potential, coupled with the doctrine of scarcity in utilizing special weapons, demands strict command control of the entire strategic air effort.

Plane Design Considerations

The above discussion of the role to be played by electronics in air war is intended to bring into proper focus one of the several elements of the complete military airplane. In the past, and to some extent today, the greatest emphasis, and an incredible percentage of Air Force resources, has gone into the development and procurement of airframes and engines. These are not complete airplanes when measured in terms of their capabilities to perform combat missions in a future war. Speed, range, and service ceiling mean nothing within themselves. Only when they are combined with ancillary devices that insure certain and precise delivery of firepower on selected targets, irrespective of geographical factors and weather conditions, do they begin to pay off.

There have been some recent indications, primarily in the strategic air command, of a better understanding of what constitutes a complete airplane. These are isolated cases and have not yet reached epidemic proportions throughout the Air Force. One can only hope that our design and development specialists, along with the balance of our operations people, will gain an early and comprehensive understanding of all the essential elements of a complete airplane and then proceed to develop and procure them concurrently. If we can accept the proposition that the overall potential of the Air Force is measured by the destructive firepower delivered upon the enemy, it follows that all the means contributing to such delivery must be developed and intelligently employed.

Conclusion

The role of electronics and communications in military air operations is a most vital one. The effective employment of Air Power is dependent upon adequate exploitation of the principles of electronics and their application to air warfare. It can be concluded that electronics and communications, though not weapons themselves, are indispensable to the employment of weapons and in the final analysis spell the difference between victory and defeat in an air war.

By Louis Hochman, Mech. Engr. and J. R. Burke, Physicist Photographic Branch, Squier Signal Laboratory, Signal Corps Engineering Laboratories

The new Signal Corps camera, right, was designed to surpass all present types of automatic still cameras. It is fully automatic, with interchangeable lenses, has high speed operation, and is constructed ruggedly enough to withstand heat, cold, and rain. The camera utilizes 70 mm perforated film and has a film transport to permit shooting at a rate of a picture a second.

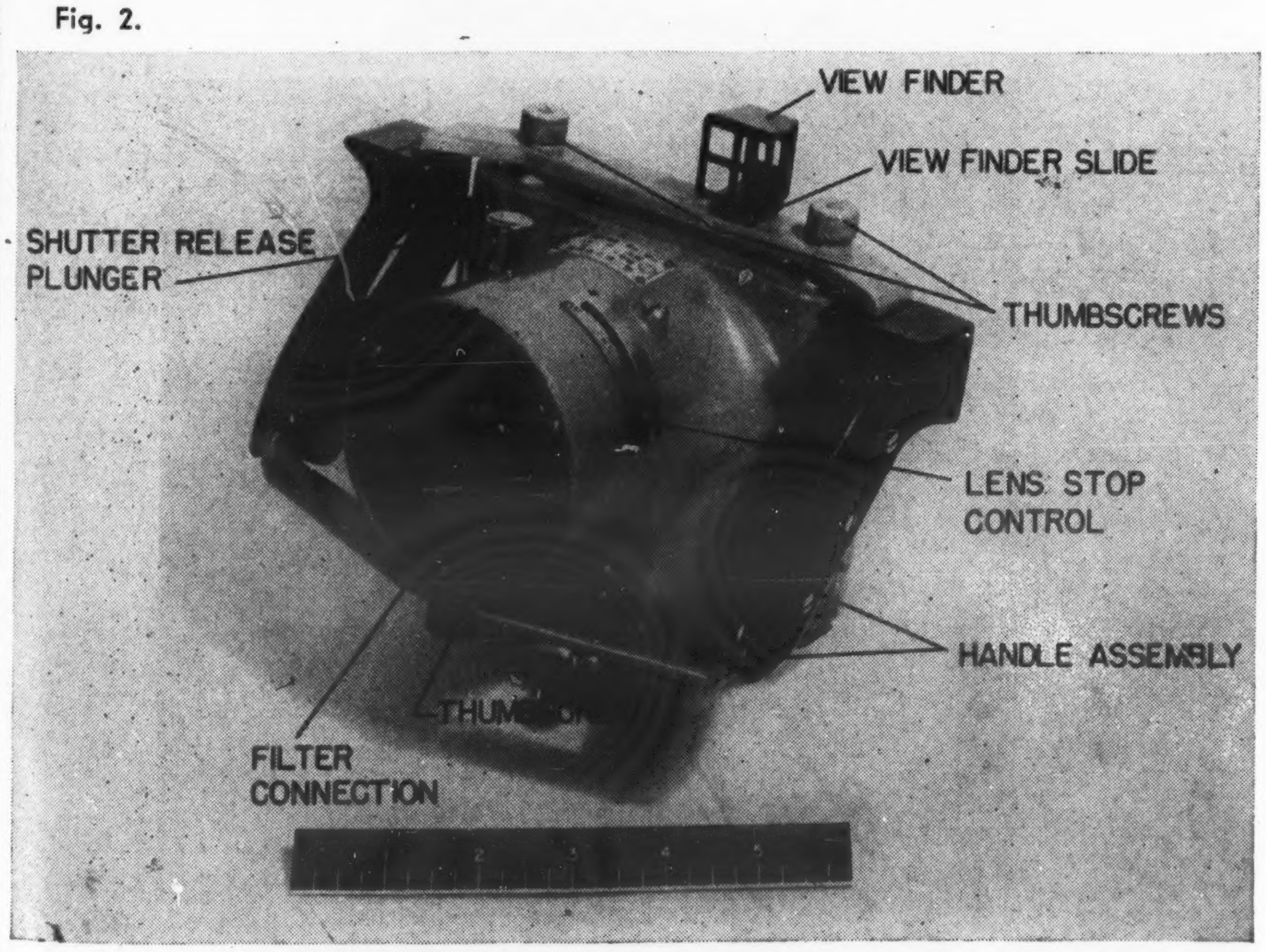
Lens equipment consists of three taking lenses; an f:3.5 of 3½-inch focal length; a wide-angle f:4.5 of 2½ inches, and a long focal length f:4.5 of 6 inches. The insertion of any of the three lenses actuates a mechanism which masks the view finder to proper picture size. The view finder and coupled range finder operate through a single eye piece. There is provision for automatic parallax correction, automatic shutter cocking, and a film counter.

Fig. 1.

NEW COMBAT CAMERA With Features Adapted from Captured Equipment

Bring a Japanese camera to a U. S. repairman and he will likely refuse to operate on it. He will tell you that the construction is so poor that he dares not probe into the camera without injury to it. But while the parts were of inferior materials, the design idea of some Japanese combat cameras was clever, and in part was considered worthy of emulation by U. S. designers. Such a camera is described here, the GSK 99.

Fig. 2.



One of the more important missions of the Signal Corps Engineering Laboratories is the development of light, durable and highly efficient military cameras and photographic equipment which will produce pictures under most adverse battle conditions of any foreseeable war.

This problem of development would be far less complex if normally available cameras used for commercial and amateur work could in all cases be purchased and used under combat conditions. But experiences in World War I, later greatly emphasized in World War II, show the majority of such equipment will not withstand the inevitably rough and tumble transportation delivering the apparatus to the theater of operations, nor the severe rigors of jungle and trench warfare once put to use by the soldier. Special design and rigorous requirements based on combat experience became a necessity.

One phase of this concerted development program of the Signal Corps is the detailed examination and testing of enemy apparatus captured during the war. Frequently, captured items of equipment are inferior to their U.S. counterpart; sometimes they are ingenious and greatly superior. Combining the best features of each is frequently the basis of a new military product, wholly superior to either the enemy or the preceding U.S. model.

An example of incorporating better features of captured equipment into U.S. produced models is in a recently produced Signal Corps camera. (Fig. 1). This new camera, which will take pictures automatically as fast as the photographer can trip the shutter, uses 70mm roll film, and is equipped with a range finder and an exposure counter, owes several of its features to certain

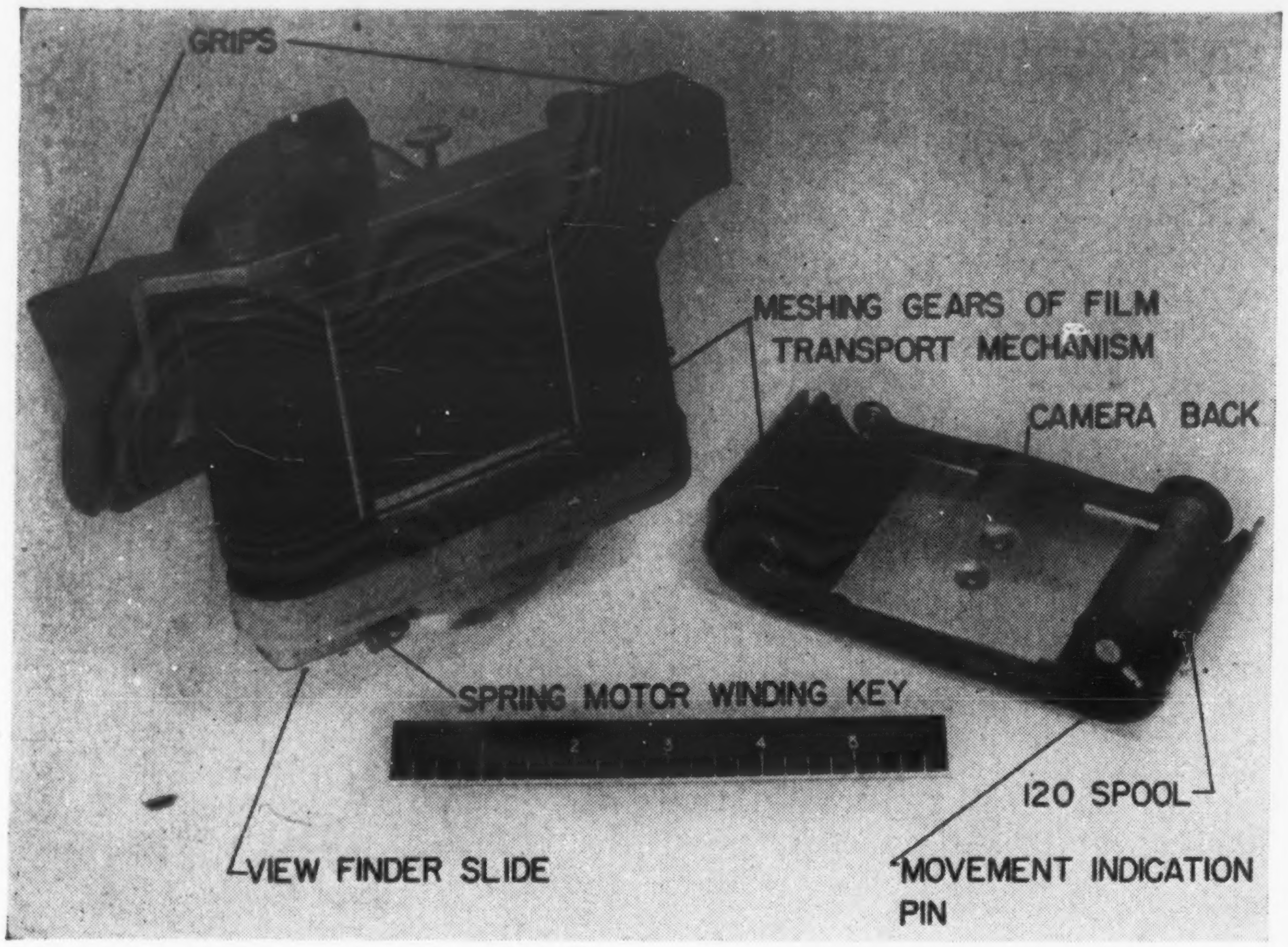


Fig. 3.

details of a Japanese camera which were considered worthy of adaptation.

This camera, the G.S.K. 99, (Fig. 2), was originally used by the Japanese Army for taking oblique aerial photographs. It was particularly adaptable to combat and other use where a minimum of manipulation by the cameraman was desirable.

The camera measures 8" x 4⅞" x 4⅞", including removable handle assembly. This handle assembly consists of a rectangular metal frame attached to the camera by thumbscrews, and fitted on both sides with wooden grips which are positioned at an angle of approximately 45 degrees to the film plane. The handle assembly allows the camera to be easily and steadily held in both hands. All controls can be operated with the fingers, even when gloved, without removing the hands from the grips. Handle assembly can be removed and the camera secured to an aircraft mount for operation by a remote control.

All operating components are placed in a protective case of heavy die cast magnesium. The lens end of the case is cylindrical in shape and has a diameter of approximately 3¼". The cylinder extends ⅞" beyond the lens, thus providing a lens shade, and some measure of mechanical protection for the lens from shock and blows. A bayonet type connection permits the filters to be readily attached and removed from the lens. A sports type viewfinder is provided, with a foot for attachment to slide bases which are fitted to both the handle and the camera body.

The equipment will take ten 2⅜" x 2⅜" exposures on a roll of standard No. 120 film. Automatic film transport and shutter cocking are provided by means of a spring wind motor, winding key for which is placed on the bottom of the case. Operation of the shutter release plunger operates the shutter, then actuates the spring wind motor, operation of which moves the next exposure into position and recocks the shutter by means of a cam.

Sufficient spring tension is available to transport a complete roll of film in this manner on one winding. Total time required to transport one exposure is approximately one second. A visual exposure counter indicates the number of pictures taken.

The back of the camera in which both the take-up spool and film spool are mounted is easily detachable, the take-up spool being fitted with a gear which meshes with the film wind mechanism when the back is attached to the camera. (Fig. 3).

The film can be changed either by changing preloaded backs, magazine style, or by simply removing the exposed roll and substituting an unexposed roll. The camera back is provided with a small pin which engages an eccentric cam attached to the film spool holder and projects outwardly through the camera use. Movement of this pin gives tactile indication of movement of the film. An ivory vinylite plate is mounted on the back for making erasable pencil notations regarding exposure data, etc.

The camera is equipped with a Hexar Series II lens of 75mm nominal focal length, provided with stops of f/3.5, f/4, f/5.6 and f/8, manufactured by Rokuohsha, Tokyo. No provision is made for focusing. Some characteristics of this lens are as follows:

Focal length	2.905
Nominal relative aperture	f/3.5
Number of elements	4
Number of glass-air surfaces	6
Coating	None

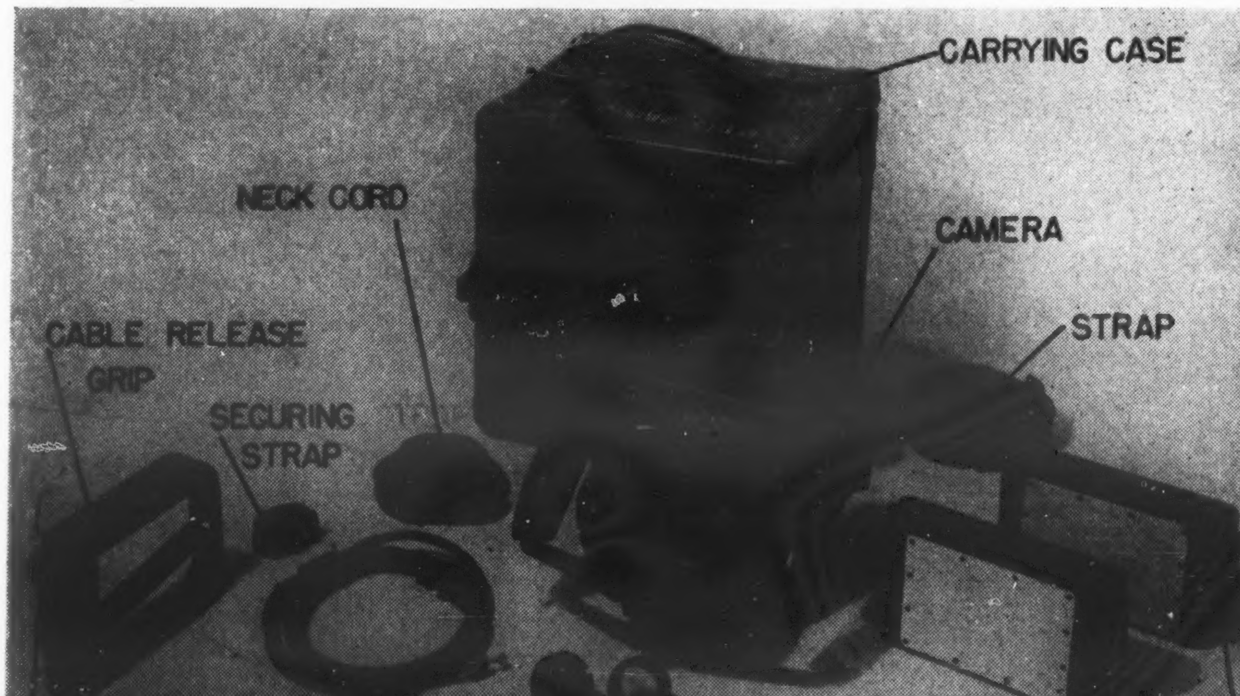
Resolving Power for White Light

Angle off axis in degrees	Lines per Millimeter Horizontal	Lines per Millimeter Vertical
0	112	112
5	112	112
10	80	80
15	20	20
20	25	25
25	40	40
30	0	0

The camera employs a Japanese-made between-the-lens-shutter of the compur type with speeds of 1/100, 1/200 and 1/400 of a second. The escapement for speeds below 1/100 is omitted, presumably for ease in manufacture.

The equipment is packed in a metal carrying case 10" x 9½" x 7½" together with accessories, which include a hand grip cable release for remote control. The grip of the cable release contains a counter for determing the number of exposures taken. Other accessories are filters and extra camera backs. (Fig. 4.)

Fig. 4.



THIRD AIR DIVISION COMMUNICATIONS

Being based in a friendly power's country in peacetime placed the Third Air Division in an unusual position with resultant problems. But they overcame the problems, says the Third, because they have "the best communication system of the best division in the best air force."

By Captain L. S. Kobel

The forming of the Third Air Division in the United Kingdom was a unique operation because of its unusual status. The provisioning of communication facilities for the division followed the same pattern. An appropriate slogan in the embryonic stages of communications for the division was "never a dull moment."

The mission of the 3rd Air Division was twofold: (1) Administration of the 59th Air Depot at Burtonwood; (2) Operational jurisdiction over B-29 aircraft based in the UK.

The primary concern of the 59th Air Depot is one of overhaul for "Vittles" aircraft on the Berlin Airlift. B-29 Bomb Groups based at Sculthorpe, Marham, and Lakenheath are normally rotated from the States on a 90-day TDY basis.

In addition to the bomb groups, the 347th Weather Reconnaissance Squadron operated initially from RAF Waddington but was later moved to RAF Marham. The mission of this weather squadron was to provide weather information principally from the North Sea area. Broadcast reports on each 100 miles of flight enabled a more accurate and dependable weather forecast to be made for "Vittles" aircraft. Weather broadcasts from aircraft were picked up by the 3AD radio station and Frankfurt. The 374th Weather Squadron recently ceased operations and has now returned to the States.

In Business

The first location of the 3rd Air Division was in the former Headquarters of General Eisenhower at Bushy Park, Teddington, Middlesex, now occupied by RAF Transport Command. A temporary set-up was made in space allotted to us by Transport Command. Unusued office space and huts were quickly swept out and made into various offices, orderly rooms, and what not. One wing of the allocated huts was turned into a communications section. A radio station was set up to handle air to ground and point to point traffic, as was also a separate USAF teletypewriter central together with a crypto-center. The 11th Communications Squadron (less personnel and equipment) was reorganized and formed at 3AD and presto! we were in business. From this point onward, as personnel were assigned, the communications section has been one of almost daily expansion and progress.

The many problems that arose were mainly due to the undefined status of the division in the United Kingdom. It was the first time that a major world power had allowed another major power to base tactical aircraft within its borders plus, of course, the use of the ground and buildings at Burtonwood for the 59th Air Depot. It is a compliment to both the British and American services that no insurmountable difficulties arose. In fact all our dealings with the various British agencies have been agreeable and on a sound common sense basis.

GPO Operates Tel & Tel

Considerable liaison and cooperation with the Royal Air Force and general post office was necessary. The general post office in the UK operates and controls all the telephone and telegraph services in the British Isles. All our wire facilities had to be obtained from the GPO and it is to their credit that the many lines and circuits required were made available to us in record time.

The RAF maintains control of frequency allocations. In the first few weeks of operation we had a feeling of frustration over frequency allocations allowed us; however, time is a great healer and we now realize how crowded the spectrum is in the UK. This tight control of frequencies is appreciated when one realizes not only the normal British commitments but also the close proximity of other nations such as France, Belgium, and the Netherlands.

Coincident with provisioning of temporary facilities at Bushy Park, plans and projects were in progress for our move to a set of new buildings at South Ruislip, Middlesex, our present location. We are all entitled to our own opinions but we here at Ruislip believe we have not only the best laid out headquarters, but also the best of communications as well. As some might say, we are "right proud" of our "Little America" here in the UK.

Present Facilities

Our communication facilities to date are as follows: A 12-position switchboard with provision for 400 extensions; private telephone tie-lines to each bomb group base, 59th Air Depot Wing, Hq, USAFE in Germany, US Embassy in London, and RAF Hq.; teletypewriter circuits to each bomb group base, 59th Air Depot Wing, Hq, USAFE, RAF Central, and Hq, USAF in Washington; a radio point-to-point net to each bomb group base, 59th Air Depot Wing, and Hq, USAFE; a radio air-to-ground channel.

AACS 1965th Squadron

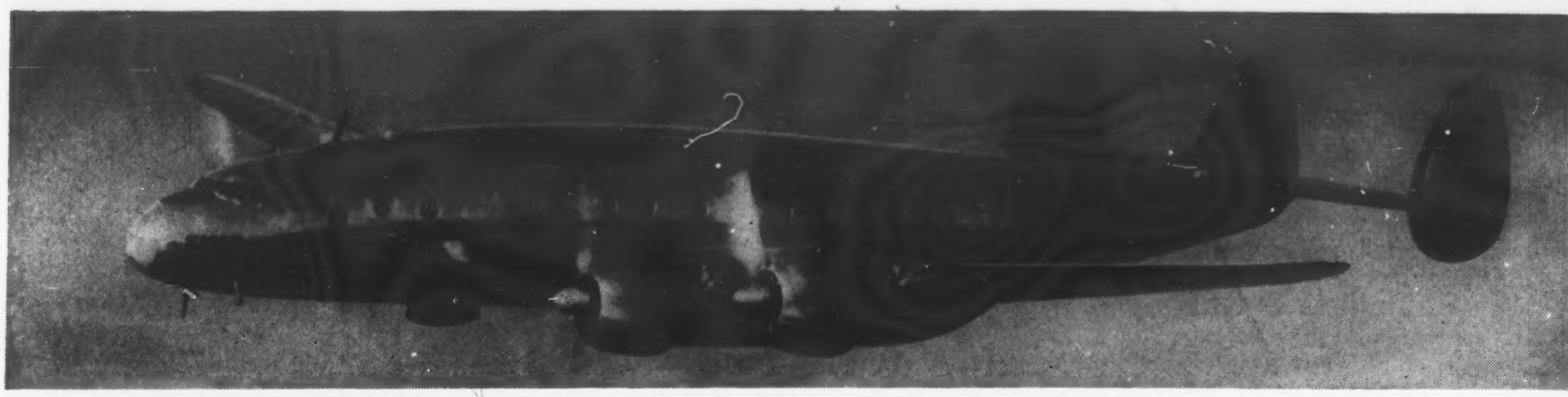
AACS participation consists of the 1965th AACS Squadron of the 1807th AACS Wing. The 1965th Squadron operates from the 59th Air Depot at Burtonwood. Their responsibilities are the facilities used at Burtonwood; control tower operations at the bomb group bases; GCA operation at Burtonwood, Sculthorpe, Marham, and Lakenheath; radar beacons at Burtonwood, Sculthorpe, and Marham; and high power radio beacons at Shawbury and Lakenheath. Close liaison is maintained with AACS activities through a liaison officer attached to the 3rd Air Division Headquarters.

Moving to our new headquarters meant also the acquisition of a transmitter site; this was obtained through the RAF and is at Bovingdon Airfield about 20 miles from Ruislip. All transmitters are remotely controlled over GPO lines from Ruislip. Recently installed at Bovingdon and Ruislip is a set of AN/TRC-1 equipment.

Currently in process are various plans and projects to either round out our facilities or improve them. Included in these plans are the setting up of facilities at Ruislip for telephone tie-lines, teletype weather lines, and facsimile equipment for the 28th Weather Squadron. AN/TRC equipment is planned for a circuit to each Bomb Group base from Ruislip.

"Best Division"

Our original slogan of "never a dull moment" still holds in our efforts to provide better and faster and more accurate communications for the 3rd Air Division. We have tried to foster an "on-the-ball" spirit amongst all our communication personnel. This we believe to be accomplished since all our personnel think that ours is the best communication system of the best division in the best air force.



Improved communications have made it possible for TWA to replace station allocations with centralized control.

Paul Goldsborough, Director of Communications, Trans World Airline.

IMPROVED COMMUNICATIONS SPEED TWA RESERVATIONS

Successful "Teleflite" reservations procedures in Trans World Airline's domestic system, plus the acquisition of additional and improved international communication facilities, have made it possible for TWA to adopt a modification of centralized space control for international reservations. Station allocation procedures used formerly have been superseded by centralized control.

System AT&T Designed

The word "Teleflite" was coined by TWA's reservations department at the time central reservations control for the domestic division was established in the airline's Kansas City office. The speedy communication system, which was designed by the American Telephone & Telegraph Company to fit TWA's needs, as determined after years of study, is the foundation upon which TWA has built its industry-wide reputation for quick and accurate reservation control.

Until the recent improvements were put into effect, space on a TWA flight was allocated to all stations from origin to destination. No one station could be given a sizeable amount of space. Because of the uncertainty of traffic flow, often one station would have need for more space than was allocated, and at other times would have more than enough to handle the demand.

Additional space was obtained through contact with other stations holding an allocation. This involved a number of communications, delays, and also the possibility that a particular station would retain open space because of the feeling that it might use it later. In many cases the final result of such a procedure was the operation of a flight with unsold space.

Central control procedures in TWA's international system were modified to a certain extent because of communication difficulties existing at some stations. Stations were allocated the absolute minimum amount of space needed to service their customers properly, and the balance was assigned to the central control office in Paris.

District offices sell from their allocation and immediately report the sale to the space control office which, in turn, releases additional space if it is available. The space control office maintains master charts on all flights.

Maximum Space Utilization

In the event there is a need for additional space not available in the space control office and a district has not reported all of the space originally assigned to it, the control office is in a position to contact that particular district and pick up the space for use by any other office having need for it.

This procedure has been found by TWA to be extremely helpful in assuring maximum utilization of all available space on any given flight, handling of group movements, working out protection on alternate flights for passengers whose original itineraries are interrupted—and enabling the control office to work closely with Flight Control in solving problems caused by irregular operations, mechanical delays and the like.

Districts Report to Control

Check procedures have been established which require the districts to report to the control office at a given time in advance of flight departure, indicating total passengers, together with destinations booked on any one flight. The control office checks this information against its records and, after consolidating information from all stations in line of flight, dispatches to all stations a complete "consist" message, showing total number of through passengers, total number of local origin passengers by station, information regarding space blocked for cargo, and information regarding any through request passengers.

The success of such a procedure depends to a great extent on the efficiency of communication service available. Paul Goldsborough, director of communications for TWA,* together with all members of the TWA communications staff concerned, are regarded as having done an outstanding job and have overcome major obstacles in setting up the necessary communications which permit the operation of the present TWA reservations procedure.

---

*Mr. Goldsborough is also one of the national directors of AFCA.

MODERN ROBINSON CRUSOES

By Helen Lawson Cutting

Far East Air Force Public Information Office

The mechanical heart of the Far East Air Force's communications is located on a lonely, windswept, desolate island 10 miles from the busy center of Tokyo. From here messages go out to far east stations at Guam, Okinawa, Saipan, Iwo Jima, Korea, the Philippines, and the distant United States.

On this island, named Tsukishima (Japanese for "Moon Island"), the responsibility for the installation and maintenance of the U. S. communications equipment belongs to the airmen of the 440th Signal Battalion (FEAF). Here they live and work, and their isolated rugged island life has prompted them to dub themselves "modern Robinson Crusoes." And while they did not arrive on the island by cause of shipwreck, the parallel of name has some justification.

There are no luxuries of living on Tsukishima. Buildings are simple, and the men fish practically from their door steps and hunt ducks from their back yards. These prizes they cook on the beach either in a skillet borrowed from the mess kitchen or on spits over an open fire.

The young airmen have none of the amusement facilities of a regular station—there is no library, movie theater, or post exchange on the island. Their club is a plain building they have constructed with their own funds.

Portion of Tsukishima Island dotted with towers. The island ground is so boggy that it is necessary to lay planks for construction trucks to stand on for heavy lifting. (Photo by S/Sgt. Roger Stockard, FEAF, PIO).

Early morning finds the men in formation to receive their work assignments for the day. They climb into trucks to ride the two-mile distance to a group of long wooden buildings squatting among reeds of the marshy island.

While the trucks roll along the men point out to a newcomer in their midst the damaged Japanese ship-repairing yards across the flow of water separating them from the mainland. The new airman cranes his neck to see the ships, among them Russian, British, Dutch, and American, all waiting for repairs. Farther along the oldtimers point to a bomb-ruined structure, its chimneys stark against the sky.

"That's the very first building," they say with satisfaction, "Jimmy Doolittle bombed on his flight over Tokyo in April 1942."

As on all military installations lacking cosmopolitan conveniences, the men do little griping, are inherently cheerful. "Robinson Crusoe never had it so good," they will tell you. One great advantage marks their duty tour — air flights to other Far East Air Force bases. Groups are rotated on temporary duty thousands of miles over the ocean. On arrival at another base the airmen fall to at the same type of work they do on their home base.

While the weather on the "Island of the Moon" is usually serene, the island is sometimes lashed by typhoons of savage intensity and the waters rise rapidly. An emergency condition was announced one fall. The last foot locker had been thrown into a truck, the last man climbed aboard as the water rose dangerously high. The truck made the bridge leading to the island a few minutes before the flood had submerged another nearby truck. When the waters receded the airmen had to start construction work afresh.

All the men of the 440th Signal Battalion are voracious readers of the Pacific Stars and Stripes published in Tokyo. Some of them attend the Army schools, working toward either a high school or college diploma. Some take correspondence courses.

Saving money to send to the soldier's deposit, a U. S. government service to enlisted men whose depositors receive four percent interest, has become a prime aim with the airmen. Their organization recently was recorded as having the highest deposits of any other in the Tokyo-Yokohama area. Colonel Maurice Simons, commanding officer of Far East Air Forces Base, commended the men on the strength of this record.

Their own commanding officer has this to say of them: "Like all young men who work in the open, the members of the Far East Air Forces 440th Signal Battalion are a healthy lot. As to easy living, isn't pride of accomplishment in a tough spot a grand substitute for luxuries—when one is young?"

ASSOCIATION AFFAIRS

ARMED FORCES COMMUNICATIONS ASSOCIATION

1624 Eye Street, NW, Washington 6, D. C. Phone: EXecutive 6991

DIRECTORS AT LARGE

Theodore S. Gary (1950)	David Sarnoff (1952), *Past Pres.*	Jennings B. Dow (1952)
Carroll O. Bickelhaupt (1950)	C. E. Saltzman (1951)	S. H. Sherrill* (1952)
Dr. Lee De Forest (1950)	Leslie F. Muter (1951)	Thomas J. Hargrave (1953)
Thomas H. A. Lewis (1950)	Dr. Frank B. Jewett (1951)	R. Adm. Earl E. Stone (1953)
Thomas A. Riviere (1950)	William S. Halligan (1951)	J. R. Cunningham (1953)
Fred R. Lack (1951)	William C. Henry* (1951)	Walter Evans (1953)
Darryl F. Zanuck (1951)	E. K. Jett (1952)	W. G. Eaton (1953)
A. W. Marriner (1951)		Paul Goldsborough (1953)

OFFICERS

President: Fred R. Lack*	*3rd Vice-Pres.:* R. Adm. Earl E. Stone	*Exec. Sec and Treasurer:* Brig. Gen. S. H. Sherrill,* U.S.A. (Ret.)
1st Vice-Pres.: Theodore S. Gary*	*4th Vice-Pres.:* J. R. Cunningham	*Counsel:* Frank W. Wozencraft*
2nd Vice-Pres.: Thomas J. Hargrave*	*5th Vice-Pres.:* Carroll O. Bickelhaupt	

*Executive Committee Member

Executive Committee Meeting

President Fred R. Lack presided at the executive committee meeting at national headquarters on September 14th. Col. Rex Corput, Office of the Chief Signal Officer; Col. T. J. Tully of Fort Monmouth; and Ralph G. Edwards, New York chapter vice pres., were also present to participate in the discussion of general plans for the 1950 annual meeting of our association. Another item discussed was the budget to cover the operation of national headquarters and the chapters during the current fiscal year.

1950 Annual Meeting

The Army will sponsor the AFCA national meeting which will be held in three locations: Signal Corps Photographic Center, Astoria, L. I., N. Y.—Friday, May 12th; New York City—Friday, May 12th; Fort Monmouth, N. J.—Saturday, May 13th.

Signal Corps ROTC Camp Awards

At the final review of the 1949 Signal Corps ROTC Camp at Fort Monmouth, N. J., July 28th, impressive ceremonies were held in presenting the first annual AFCA award to the honor cadet at the camp. Robert G. Chamberlin of the State College of Washington was the student selected by camp authorities as the one who "has demonstrated leadership qualifications above the average, inspiring the confidence and support of those who work with and for him. By his accomplishments and devotion to duty during the period of camp training, he has reflected high credit on the ROTC and contributed his share toward the protection of the American way of life through greater military security."

Mr. Fred R. Lack, AFCA President, came from New York to make the presentation of a scroll setting forth the basis of the award, a special AFCA medal for wear on the ROTC uniform, a lapel emblem for wear on civilian clothes, and an honorary membership in AFCA. Of more lasting value and of special significance to Cadet Chamberlin was a copy of General Dwight D. Eisenhower's historical book, "Crusade in Europe", personally inscribed by the great World War II commander: "To the No. 1 ROTC Student, Summer Camp, Fort Monmouth, N. J., 1949. With congratulations from Dwight D. Eisenhower." The informal presentation of the book was made for General Eisenhower immediately after the review by Brig. Gen. S. H. Sherrill, AFCA Executive Director, who had been commander of ROTC camps at Monmouth for three summers in the 1920s while on duty as Asst. PMS&T at Carnegie Institute of Technology.

The importance to national defense of this first annual award was emphasized by the presence in the reviewing party of many civilians and military leaders distinguished in the communications field. Fort Monmouth's com-

WHEN DOES YOUR MEMBERSHIP EXPIRE?

Look at the expiration date on your membership card. If it is within 30 days, it's time to pay your dues. Fill in this form and return with the correct remittance. If you do not use the form please pass it on to a friend for his use in applying for membership.

Armed Forces Communications Association
1624 Eye Street, N. W., Washington, D. C.

Enclosed is $................ for membership (new (renewal) for one year in the AFCA.
(Full—$5.00) (Retired or Enlisted—$3.00) Student ($2.00)

Name ....

Address ....

City.............................. State..............................

Addresses Unknown

Mail addressed to the following members has been returned to us. If you know the present address of any of them please jot it down on a post card and send it to us.

Larry P. Allred
E. R. Archambeau
G. E. Berry
Jim Biehn
Eugene V. Boren
David C. Davis
Capt. Arthur M. Fredenburg
Ralph Fullwood
T/5 John C. Gall
L. M. Huffman
Lt. Howard Kaplan
Major Charles F. Ludden
James B. McGillis
James T. Nash
Thomas C. Penn
Capt. Erhard R. Pufahl
J. E. Rider
Lt. Douglas M. Ross
Stewart L. Seaman
Ray Self
William A. Skoog
Don Sloan
Major Bernard Starzyk
Hal B. Tucker
Col. J. C. Underwood
Elo N. Vani
Marvin A. Woodward

National Advisory Committee Chairmen

BATTERY MANUFACTURING: **Dr. George W. Vinal, Bureau of Standards, Washington, D. C.**

DRY BATTERY SUBCOM.: **Mr. Ralph E. Ramsay, V. Pres. & Research Director, Ray-O-Vac Company, Madison, Wisconsin**

STORAGE BATTERY SUBCOM.: **Mr. L. E. Wells, Chief Engineer, Willard Battery Company, Cleveland 1, Ohio**

PHOTOGRAPHIC EQPT. SUBCOM.: **Mr. H. A. Schumacher, V. Pres., Graflex, Inc., Rochester, N. Y.**

PHOTOGRAPHIC SENSITIZED MATERIALS & CHEMICALS: **Joseph C. Wilson, Pres., The Haloid Co., Rochester, N. Y.**

PUBLICITY: **Mr. Orrin Dunlap, Jr., RCA, 30 Rockefeller Plaza, New York 20, N. Y.**

MILITARY TRAINING: **Major Gen. G. L. Van Deusen, Pres., RCA Institutes, Inc., 340 West 4th St., New York 13, N. Y.**

mander, Maj. Gen. F. H. Lanahan, Jr., addressed the ROTC students during the ceremony explaining the purpose of the AFCA award and of the Association itself, membership in which is open to all the students. He then introduced the distinguished guests who had come from New York and Washington. They included Maj. Gen. Spencer B. Akin, Chief Signal Officer, and Maj. Gen. J. O. Mauborgne, former C Sig O, both of whom are honorary life members of the association; Maj. Gen. W. H. Harrison, a charter member, and now president of IT&T Corp.; Maj. Gen. G. L. Van Deusen, chairman of AFCA's advisory committee on training and now president of RCA Institutes; Brig. Gen. C. H. Arnold who has directed the procurement and distribution of all Signal Corps supplies for the past four years; Dr. H. H. Buttner, president of Federal Telecommunications Labs; Brig. Gen. C. O. Bickelhaupt, charter member, and now vice-president of AFCA and vice-president of AT&T Co.; Brig. Gen. Harry Reichelderfer, recently appointed director of the Signal Corps Engineering Labs; Col. Ralph Hart of the Western Electric Co.; and Brig. Gen. S. H. Sherrill.

Col. Louis J. Tatom, president of AFCA's Fort Monmouth Chapter, introduced the association's president, Mr. Fred R. Lack of Western Electric, New York, who, in addition to making the award to Mr. Chamberlin, presented a scroll to 2nd Lt. Vincent J. Romano, winner of AFCA's award to the Rutgers University ROTC honor student during the academic year 1948-49.

New Life Member

Marcel Wallace of Byram, Connecticut, has become a life member of the association.

Changes in AFCA Emblem

Capt. B. Harold Christenson, who designed the AFCA emblem, has agreed to submit a plan for changes to emphasize equally the position of the three services in the association.

Adm. Redman Made Life Member

Rear Admiral John R. Redman, new Chief of Naval Communications, has been made an honorary life member of the association. This is in accordance with the policy established by the AFCA board of directors last spring of extending honorary life memberships to each of the three chiefs of communications upon appointment.

Honor Roll

The Council voted in June to follow the lead of several professional societies and establish an honor roll for the purpose of perpetuating the names of distinguished pioneers and members now deceased of the association. Not more than one name may be added each year to this list. Elected by the Council were:

Maj. Gen. C. M. Saltzman, former Chief Signal Officer, who, with Brig. Gen. J. J. Carty, also named, founded the American Signal Corps Association after World War I.

Brig. Gen. J. J. Carty, distinguished industrialist, formerly with the AT&T Co., and reserve officer.

Maj. Gen. George S. Gibbs, former Chief Signal Officer, later president of Postal Telegraph Co., and charter life member of this association.

Associate, Student Members

1st lieutenants and lieutenants (j.g.) and below are now eligible for the $3 associate membership. Student membership at $2 is now available for USMA, USNA and technical school students for one year after graduation as well as while in undergraduate status.

Honor Chapter

Although the competition for "Chapter of the Year" is in its third year, this year is the first "Honor Chapter" contest. The New York Chapter was in the lead on July 30th, with the Chicago Chapter second. This contest was initiated to increase the number of our group members through recruiting activities by the chapters. (See July SIGNALS)

USMA Radio Club

At a conference August 2nd in the club rooms of the Cadet Radio Club at West Point with Lt. Col. L. G. Forbes, officer in charge of the club, Executive Director S. H. Sherrill agreed to arrange a visit for the club members to a Navy communication installation. Col. Forbes reported that there are some 250 cadets who are members of the club and that probably 50 of these would be expected to participate in the proposed inspection trip. It was agreed that a visit to the USS *Adirondack* and perhaps the USS *Requin*, the two electronics ships which featured AFCA's 1949 meeting in Washington, would be intensely interesting and instructive. It is expected that it can be arranged to have these or similar vessels at the New York Navy Yard for the proposed visit next spring. Such visits should

increase the interest of the cadets in communications and electronics and give them an idea of activities in these fields in the Navy. This year the club visited the laboratories at Fort Monmouth, a trip which would be continued making two or more such trips for the cadets.

Eastern Signal Association

The Eastern Signal Association, comprised of enlisted and officer personnel who served during the recent war with the E.S.C., R.T.C. or E.S.C., U.T.C., held their first reunion at Fort Monmouth on 2-4 September. Permanent organization was established and national officers elected. About 60 officers, enlisted men and their ladies attended the banquet and participated in the social activities of the weekend. Details of the organization will appear in the November issue.

West Point Chapter

The Executive Director visited West Point August 9th to discuss with Col. James Green the advisability of forming a chapter there of cadets interested in radio "ham" activities, and the success in stimulating interest in communications that has resulted from our annual award in electronics.

Transport Communications

Communications play a vital part in the operations of steamship, railroad, and airlines. National headquarters has circularized the companies in these fields and many have agreed to invite their communications executives and other personnel to join the association through publicity in their journals and other publications.

New Ordnance Chief

The Executive Director visited Aberdeen Proving Ground August 28th to pay his respects for the association to the newly appointed Chief of Ordnance, Maj. Gen. E. L. Ford, and to secure information from the Aberdeen post which might be helpful to some of our own local units. Gen. Ford has had a brilliant career in the Army beginning with his selection to be first captain of the U. S. Corps of Cadets in 1917. Dr. C. F. Pickett, president of the Aberdeen post of the Ordnance Association, summarized its activities for the past year which included tours through the Glen L. Martin aircraft plant and the Lukens Steel Co. plant.

Chapter Guide

A handbook for use by chapter officers in planning activities and conducting the chapter business has been prepared by national headquarters and distributed to the chapters. The manual was written after exhaustive study of other association activities, of guides published by some of them, comments on the tentative guide issued during the first year of our association's existence, and the findings of the Gary committee based on questionnaires returned by six selected chapters and the discussions at the chapter panel at the 1949 annual meeting in Washington. The handbook is in mimeograph form and will be replaced by a printed pamphlet next year after chapters have submitted recommendations for changes at the 1950 annual meeting.

It is expected that this guide will be of immediate and real value. By keeping it always at hand, it may answer many questions and provide ideas for those elected to administer local chapters so that they may be strong factors for communications, electronics and photography preparedness throughout the U. S.

Governor Arthur Langlie of Washington presents AFCA medal to ROTC award winner Terrence S. Meade, State College of Washington.

Chapter Lecture Series

Mr. W. H. Mansfield, AFCA's representative for the Southeastern area, has arranged a series of demonstration-lectures on "Micro-Radio Waves in Civil and Military Communication" by Dr. J. O. Perrine, assistant vice-president of the American Telephone & Telegraph Company. Dr. Perrine has been scheduled to appear before the following chapters: South Carolina on August 31st; Augusta-Camp Gordon on

---

Editorial from the Augusta (Georgia) Herald

Communications Group Shows How to Unite Armed Services

While the powers that be in Washington are having difficulty upon difficulty in bringing about a workable unification of the armed forces the men and women of these services have gone quietly about their business and unified themselves into a congenial and useful association.

This group, the Armed Forces Communication Association, promises to bring about an understanding and fellowship between the branches of the armed services and the public that at one time would have been termed impossible.

This organization which recently chartered the Augusta-Camp Gordon Chapter, is devoted solely to the National defense. It has no commercial interests . . . no political alliances, and no religious affiliations. It is not operated for profit and its income from dues, etc., is expended solely for furthering the patriotic aims for which it was founded.

It is aimed at the promotion of efficiency in military communications and photography, especially through better liaison between industry and the armed forces as well as among the three services themselves. It also seeks to foster fraternal relations among all branches of the service, Regular and Reserve from which the members are drawn.

As an example of the unity being brought about by the group the local chapter which is made up mainly of Army and ex-Army members has named an ex-Navy man as its first president.

The congeniality which has been paramount in the first three meetings of the chapter is a splendid example of intentness of purpose and cooperation in working toward a goal.

Communications form the brain of a modern defense force and unless we continue to maintain the best in the world we will become the prey of the first nation that sets its heart on conquest.

The local chapter is expected to become one of the largest in the South with Camp Gordon, the Arsenal, the Oliver General hospital and the many civilian and reserve groups from which it can draw members.

The National Guard, the Marine Reserves, the Army Reserves, the Navy Reserves and others provide a wide range of potential affiliates.

All of these and civilian groups can learn much and gain a deep insight into the national defense through the demonstrations of various communications set-ups that will be given before the chapter in the future.

National experts are being lined up for these demonstrations now, and within the next few months will be regular features at the meetings.

We are proud to commend the officials responsible for the setting up of the local chapter and wish for them the success that their auspicious start indicates for them.

September 1st; Atlanta on September 6th; and Louisiana on September 8th.

Dr. Perrine, who holds degrees from the Universities of Iowa and Michigan and from Cornell University, was a captain in the Signal Corps during World War I, having charge of telephone and radio at the Signal Corps officers' training school at Yale University. He remained at Yale on the engineering faculty until 1921, when he joined the department of development and research of the American Telephone & Telegraph Company, doing development work in the field of electrical communication and later becoming an editor of the Bell System Technical Journal. He was the AT&T representative at the World's Congress of Telephone Engineers and World's Congress of Physicists at Como, Italy.

In 1928 and 1930 Dr. Perrine gave the De Forest lecture in communication at Sheffield Scientific School, Yale University. During recent years, he has given talks and demonstrations before college, civic and scientific organizations throughout the United States and Canada. He has a particular facility and technique of reducing the intricacies of complex electrical phenomena to the level of the average man's understanding.

In his lectures before the chapters, Dr. Perrine will transmit speech and music over microwave radio beams and will conduct a number of spectacular demonstrations illustrating the characteristics of these ultra-short radio frequencies. In addition, he will discuss the application of recent electronic developments to multi-channel telephony, telegraphy and television.

Procurement Information

A central directing service to businessmen seeking contracts with the military services has been opened by the Munitions Board. The address is as follows:

Military Procurement Information Office
Room 3-D-773
The Pentagon
Washington 25, D. C.

The phone number is REpublic 6700, Extension 75321.

The new office, staffed by representatives of the Army, Navy, and Air Force, was established at the direction of Secretary of Defense Louis Johnson as a guide service to businessmen. Its chief function will be to direct businessmen to the appropriate offices of the military services which may be in the market for their products or services. The center will *not* assist in *obtaining* contracts.

The Munitions Board points out that the center will be of primary value to concerns who are not accustomed to doing business with the armed services.

INDUSTRIAL MINUTE MEN OF 1949

Communications—Electronics—Photography

Listed below are the names of the American firms who are group members of the Armed Forces Communications Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation in our special fields.

Acme Telecronix
American Institute of Electrical Engineers
American Phenolic Corporation
American Radio Relay League
American Steel & Wire Company
American Telephone & Telegraph Co.
Anaconda Wire & Cable Company
Arnold Engineering Company
Astatic Corporation
Automatic Electric Company
Automatic Electric Sales Corp.

Baltimore News Post
Baltimore Radio Show, Inc.
Barry Corporation, The
Bell Telephone Company of Pa.
Bendix Radio
Bliley Electric Company
Breeze Corporation, Inc.
Burnell & Company

California Water & Telephone Co.
Capitol Radio Engineering Inst., Inc.
Carolina Telephone & Telegraph Co.
Central Radio and Television Schools
Chesapeake & Potomac Tel. Co.
Chicago Telephone Supply Co.
Cincinnati & Suburban Bell Tel. Co.
Collins Radio Company
Copperweld Steel Company
Cornell-Dubilier Electric Corp.
Corning Glass Works
Coyne Electric School, Inc.

DeJur-Amsco Corporation
Diamond State Telephone Co.
Allen B. DuMont Laboratories, Inc.

Eastman Kodak Company
Hugh H. Eby, Inc.
Electronic Associates, Inc.
Electronic Designs, Inc.
Espey Manufacturing Co., Inc.

Federal Mfg. and Engineering Corp.
Federal Telephone & Radio Corp.

General Aniline & Film Corp.
General Cable Corporation
General Electric Company
General Instrument Corp.
General Telephone Corp.
Gilfillan Bros. Inc.
Globe Wireless, Ltd.
Gray Manufacturing Co.

Hallicrafters Company
Haloid Company
Hazeltine Electronics Corp.
Heinemann Electric Company
Hercules Motors Corp.
Hoffman Radio Corp.

Ilex Optical Co.
Illinois Bell Telephone Co.
Indiana Bell Telephone Co.
Indiana Steel & Wire Co.
Institute of Radio Engineers
International Resistance Co.
International Tel. & Tel. Corp.

Jacobsen Manufacturing Co.

Kellogg Switchboard & Supply Co.
Kleinschmidt Laboratories, Inc.

Lasting Products Co.
Lavoie Laboratories
Leich Sales Corporation
Link Radio Corporation

Machlett Laboratories, Inc.
Magnavox Company
P. R. Mallory & Co., Inc.
Massachusetts Radio & Telegraph School
Merit Coil and Transformer Corp.
Michigan Bell Telephone Company
Mines Equipment Company
Motorola, Inc.
Mountain State Tel. & Tel. Co.

National Carbon Company, Inc.
National Fabricated Products, Inc.
New England Tel. & Tel. Co.
New Jersey Bell Telephone Company
New York Telephone Company
North American Philips Co., Inc.
Northwestern Bell Telephone Co.

Oak Manufacturing Co.
Ohio Bell Telephone Co.
O'Keefe & Merritt Company
Operadio Manufacturing Company

Pacific Telephone & Telegraph Co.
Philco Corporation
Photographic Society of America

Radiart Corporation
Radio Condenser Company
Radio Corporation of America
RCA Victor Division
Ray-O-Vac Company
Reeves Instrument Corp.
Remington Rand, Inc.
Rola Company, Inc.

Sherron Electronics Co.
Society of Motion Picture Engineers
Sonotone Corporation
Southern Bell Tel. & Tel. Co.
Southern New England Tel. Co.
Southwestern Bell Telephone Co.
Sperry Gyroscope Company
Stackpole Carbon Company
Stewart-Warner Corporation
Stromberg-Carlson Co.
Stupakoff Ceramic & Mfg. Co.
Sylvania Electric Products, Inc.

Telephone Services, Inc.
Telephonics Corporation
Teletype Corporation
Times Facsimile Corporation
Tri-State College
Tung-Sol Lamp Work, Inc.

United Radio Television Institute
United States Electric Mfg. Corp.
United States Rubber Company

West Coast Telephone Company
Western Electric Company, Inc.
Western Union Telegraph Co.
Westinghouse Electric Corp.
Weston Electrical Instrument Corp.
Willard Storage Battery Co.
Wisconsin Telephone Company
Wollensak Optical Company

Chapter News

National Director of Chapters: Theodore S. Gary, 1033 W. Van Buren St., Chicago, Ill.

AREA REPRESENTATIVES FOR CHAPTERS

Area A: George P. Dixon, IT&T Corp., 67 Broad St., New York, N. Y. New England States, New York, New Jersey

Area B: J. H. LaBrum, Packard Building, Philadelphia, Pa. Delaware, Kentucky, Maryland, Ohio, Pennsylvania, West Virginia and Virginia

Area C: W. H. Mansfield, So. Bell T&T Co., Atlanta Ga. Southeastern States along Atlantic and Gulf coasts—from North Carolina to Louisiana including Tennessee.

Area D: H. L. Reynolds, 1800 N. Market St., Dallas, Tex. New Mexico, Texas, Oklahoma, Arkansas

Area E: T. S. Gary, 1033 W. Van Buren St., Chicago, Ill. Mich., Ind., Ill., Wisc., Minn., Iowa, Mo., Kans., Neb., N. Dak., S. Dak., Wyo., Col.

Area F: H. L. Hoffman, 3761 S. Hill St., Los Angeles, Calif. Arizona, Utah, Nevada, California, Idaho, Oregon, Montana and Washington

Individuals interested in chapter activities should communicate either directly with National Headquarters or with the proper area representative.

CHAPTERS AND SECRETARIES

ATLANTA: Capt. Dewey Allread, Jr., Bldg. 104, Apt. 1, Ft. McPherson, Ga.

AUGUSTA-CAMP GORDON: Maj. Norman J. Kinley, SCTC, Camp Gordon, Ga.

BALTIMORE: Henry W. Williams, 3953 Cloverhill Rd., Baltimore 18, Md.

BOSTON: Lt. Col. Edmund T. Bullock, Boston Army Base, Boston 10, Mass.

CHICAGO: Raymond K. Fried, 111 W. Monroe St., Chicago 1, Ill.

CLEVELAND: T. F. Peterson, 1434 Union Commerce Bldg., Cleveland 1, Ohio.

DALLAS: E. H. Mittanck, Rm. 816, Telephone Bldg., Dallas, Tex.

DAYTON: Gertrude A. Knight, 54 Patterson Village Dr., Dayton, Ohio.

DECATUR: Doris E. Short, 140 No. Hilton St., Decatur, Ill.

EUROPEAN: C. E. Laurendine, Comm. Gp., BiPartite Control Office, Frankfurt, APO 757, New York.

FAR EAST: Lt. Col. Roy F. Blackmon, Sig. Sec., GHQ., FEC, APO 500, c/o PM, San Francisco, Calif.

FORT MONMOUTH: Dorothy Dean, Library, Coles Signal Lab., Red Bank, N. J.

GREATER DETROIT: Robert J. Derr, 20038 Pinehurst Ave., Detroit, Mich.

KENTUCKY: Clyde T. Burke, Lexington Signal Depot, Lexington, Ky.

LOUISIANA: A. Bruce Hay, Southern Bell Tel. & Tel. Co., New Orleans, La.

NEW YORK: William H. Harrington, 195 Broadway, New York 7, N. Y.

OGDEN-SALT LAKE: Inactive.

PHILADELPHIA: Joseph Bergman, Sig. Corps Stock Control Agency, 2800 So. 20th St., Philadelphia, Pa.

PITTSBURGH: K. A. Taylor, Bell Telephone Co., 416 7th Ave., Pittsburgh, Pa.

RICHMOND: Lelia V. Fussell, Ches. & Potomac Tel. Co., 703 E. Grace St., Richmond, Va.

RIO: Inactive.

SACRAMENTO: Capt. C. A. House, Sacramento Signal Depot, Sacramento, Calif.

SAN FRANCISCO: J. K. Fairchild, 55 Madrone, Fairfax, Calif.

ST. LOUIS: A. Reid Chappell, 70 York Drive, Brentwood, Mo.

SEATTLE: Clarence C. Bodine, 6812 Phinney Av., Seattle, Wash.

SOUTH CAROLINA: John A. Norman, Southern Bell T&T Co., Columbia, S. C.

SOUTHERN CALIFORNIA: K. E. Lambert, MGM, Hollywood, Calif.

SPANISH WAR VETERANS DIVISION: George A. Marshall, Adj., 215 Montague St., Brooklyn, N. Y.

WASHINGTON: Col. Edward C. Cover, Chesapeake & Potomac Tel. Co., 725 - 13th Street, N. W., Washington, D. C.

STUDENT CHAPTERS

CORNELL: John M. Ross, 126 McFaddin Hall, Ithaca, N. Y.

NEW YORK UNIVERSITY: Robert D. Hawkins, 25 Spruce Ave., Ridgefield Park, N. J.

OKLAHOMA A & M: W. D. Manahan, Okla. A & M College, Stillwater, Okla.

STATE COLLEGE OF WASHINGTON: Stuart W. McElhenny, 604 California St., Pullman, Wash.

TEXAS TECH: Raymond D. Self, Veterans Village, Lubbock, Tex.

UNIVERSITY OF CALIFORNIA: R. G. Barhite, Bowles Hall, U. of Calif., Berkeley, Calif.

NATIONAL HEADQUARTERS CHAPTERS SECRETARY: JULIA B. GODFREY

Boston

Rear Admiral T. F. Halloran of the General Communication Company is considering accepting the invitation of AFCA national headquarters to initiate action toward the rehabilitation of the Boston chapter which has not been active since it was formed in November 1947.

Cleveland—L. J. Schaffer, Pres.

The Cleveland chapter announces that a membership drive is being gotten under way to coincide with its first 1949 fall meeting, October 13th.

The meeting is to take place at the U. S. Coast Guard Station, Cleveland.

Chapter Of The Year, 1949

KENTUCKY

President—Murray P. McQuown

Past Pres.—William M. Mack

Secretary—Clyde T. Burke

Greater Detroit—R. J. McElroy, Pres.

The first fall meeting will feature a lecture and demonstration of the Air Force's tri-dimensional photography show by Col. George W. Goddard, chief photographic laboratory, engineering division, USAF.

Louisiana—P. M. Miller, Jr., Pres.

A business meeting was held on June 7th at the St. Charles Hotel, New Orleans. A chapter constitution and by-

laws were adopted and officers were elected for the ensuing year as follows: President—Peter M. Miller, Jr., New Orleans Public Service; vice presidents—Capt. Glenn W. Legwen, USN; Col. A. H. Schroeder, USA; Col. Herbert B. deBuys, AF-Res.; George W. Healy, Jr.; Curtis G. Walther; C. J. Briant; Rev. Thomas J. Shields, S.J., president of Loyola University; treasurer—George A. Mayoral, station WRCM; secretary—A. B. Hay, Southern Bell T&T Co.

Mr. H. B. Lackey of Southern Bell T&T Co., who had served as interim president of the chapter, then gave a report of the AFCA national meeting in Washington.

New York—G. P. Dixon, Pres.

The president of the chapter was commended in a recent letter from national headquarters which read as follows:

As you know, we have been conducting an exhaustive study here at national headquarters of the part the local chapters can and must play toward making our Association a stronger organization. I feel that the officers and members of AFCA owe a great deal to your officers and your entire chapter for the example you have set in reorganizing the old Signal Corps Association chapter and conducting it in a most efficient manner. It seems to me that the New York Chapter stands as a beacon light to show what can be accomplished when wisdom and enthusiasm are combined.

Chapters must be built up slowly, patiently and under many difficulties. Not the least of these difficulties is the usual post-war apathy toward things military—although it is not now nearly as universal as it was after World War I. Organization and reorganization work similar to what you are doing is being undertaken in other cities—with varied results. We are agreed that this is the most constructive work that can be done at this time for the welfare of our Association. Surely, it is the most fruitful means of recruitment and the most effective agency we have for the maintenance of membership interest.

No one knows better than you that the original creation of each chapter is largely the vision and work of one or two enthusiastic workers. It will be so in every chapter. These leaders must spring up from the members with the feeling that they have a mission. They can enlist help and will receive it. But they themselves must be the driving power. There is an urgent need for this type of leadership in the chapters, which are themselves so essential to our continued growth.

Baltimore chapter tours Western Electric Company Point Breeze plant, Baltimore, Md. Shown here at the plant are L to R: E. K. Jett, a Western Electric Co. guide, C. H. Johnson, Brig. Gen. S. H. Sherrill, F. E. Moran, Col. H. E. Storms, and A. B. Goetz.

Since all of these things are found in your chapter, I want you to know how much we appreciate your personal leadership and that of the others who help you to keep the New York Chapter the intensely alive unit that it is.

South Carolina—F. M. Fister, Pres.

Some 250 members and guests attended the chapter meeting at the Columbia Hotel, Columbia, August 31st, which featured Dr. J. O. Perrine's demonstration-lecture on "Micro-Radio Waves in Civil and Military Communications." The audience included a large delegation from the Charleston Navy Yord, as well as Army personnel from Fort Jackson and representatives of the communications industry.

Officers elected to guide the chapter during its first year are: president—Fred M. Fister, South Carolina chief engineer, Southern Bell Telephone Co.; 1st vice-president—Capt. Joseph B. Berkley, USN, Charleston Naval Shipyard; 2nd vice-president—Theodore A. Brunner, post signal officer, Fort Jackson; secretary—John A. Norman, div. construction supervisor, Southern Bell Telephone Co.; treasurer—Albert L. Ragsdale, Prof. of Physics, University of South Carolina.

Chapter of the Year Contest

As of August 31st, the following were in the lead:

Pittsburgh
European
Southern California
Sacramento
Augusta-Camp Gordon

Pittsburgh—E. J. Staubitz, Pres.

The annual election of officers took place at the first fall meeting on September 13th in the Bell Telephone Building. The program included a round-table discussion of the types of meetings desired during the year and the objectives to be accomplished.

The new officers are: president—Edward J. Staubitz, Blaw-Knox Company; 1st vice president—Donald L. Chaffee, Copperweld Steel Co.; 2nd vice president—Eugene C. Stern, Bell Telephone Co.; treasurer—Charles A. McKenney, Jr., Peoples First National Bank & Trust Co.; asst. treasurer—Hobart H. Drake, Jr., Rust Engineering Corp.; secretary—Sylvester C. Stoehr, Jr., Bell Telephone Co.

Southern California—H. W. Hitchcock, Pres.

The July meeting of the Southern California Chapter was addressed by Commander Frederick Y. Smith, USNR, on the uses of photography in the Navy. Commander Smith illustrated his talk with films, made by units with which he had been associated, of the large rocket "Tiny Tim" and of the experiences of the carrier *Franklin.*

Washington—F. H. Engel, Pres.

The officers and directors of the Washington chapter met on July 12th at the Raleigh Hotel. Commander A. L. Jenkins was chosen as general counsel of the chapter. Committee chairmen were appointed as follows: Publicity—Roland P. Davies, publisher of Telecommunications Reports; Membership—James F. O'Donnell, Chesapeake & Potomac Telephone Co.; Program—W. J. McManus, vice-president—public relations, C&P Telephone Companies.

AFCA INDIVIDUAL MEMBERS

Following is a list of AFCA individual members as of June 30, 1949. Life, honorary, associate, and student members are not included in this list. Military grades and ranks are not shown. If your name does not appear in this listing, or if it is shown incorrectly ask national headquarters for an explanation. If your friends, interested in communications, electronics, or photography are not listed here please tell them of our association and its purposes.

Abel, A. E.
Abbott, G. C.
Abbott, H. C.
Abraham, A. A.
Abramowitz, R.
Abrams, A. G.
Abrams, T.
Abreu, L. A.
Acheson, M. A.
Adair, F. L.
Adair, G. W.
Adamitis, W. J.
Adams, A. F.
Adams, B. R., Jr.
Adams, F. I.
Adams, F. R.
Adams, H. W., Jr.
Adams, H. W.
Adams, J. W.
Adams, J. P.
Adams, J. B.
Adams, N. I., Jr.
Adams, W. R. F.
Adams, W. M.
Adamson, A. L.
Addington, J. R.
Adey, E. A.
Adie, H.
Adinaro, J. T.
Adrian, F. M.
Ahern, J. P.
Agee, J. H.
Ahlstrom, N. H.
Akerstrom, O. W.
Akins, H. D.
Albert, D. E.
Alberts, A. A.
Albright, J. A.
Albright, O. S.
Aldridge, R. R.
Alexander, J. K.
Alexander, K. B.
Alfs, W. A.
Alisch, E. P.
Allen, A. J.
Allen, D. E.
Allen, G. L.
Allen, H. E.
Allen, H. M.
Allen, J. C.
Allen, M. H.
Allen, R. S.
Allen, S. M.

Allman, C. L.
Allmon, J. C.
Allread, D., Jr.
Althoen, H. M.
Amason, W. H.
Amato, J. J.
Anderegg, F.
Anderson, C. P.
Anderson, G.
Anderson, H. C.
Anderson, J. W.
Anderson, L. F.
Anderson, R. W.
Anderson, V. J.
Anderson, W. C.
Anderson, W. W.
Andrews, F. P.
Angel, C. S.
Angeny, F. G.
Angevine, R. A.
Angster, R. C.
Anstine, L. T.
Anton, G. S.
Anton, N.
Appl, T. A.
Appleton, L. B., Jr.
Arbatsky, N.
Arbogast, L. W.
Archambeau, E. R.
Arkell, W. C.
Armitt, H. T.
Armstrong, A. M.
Armstrong, G. W.
Armstrong, H. C.
Armstrong, M. C.
Armstrong, R. F.
Arnn, C. M.
Arnold, C. H.
Arnold, C. N.
Arnold, C. B.
Arnold, E. R.
Arnold, J. R.
Arnold, J. W.
Arthur, G.
Arthur, H. G.
Ashe, R. B.
Askew, M.
Athan, H. W.
Atherton, J. B.
Atlas, H. T.
Atwood, F. J.
Augustine, W. J.
Auker, D. E.

Austin, F. B.
Autry, R.
Avent, J. K.
Avery, W. G.
Ax, L. S.
Ayres, A. L.

Babb, K. L.
Bach, W.
Back, F. G.
Back, G. I.
Badden, W. E.
Badmaieff, A.
Bady, I.
Baer, C. M.
Bagby, C. K.
Bagley, R. M.
Bagnall, V. B.
Bailey, W. M.
Baird, V.
Bairos, C. A.
Baker, A.
Baker, F. L.
Baker, G. K.
Baker, T. M.
Baker, W. R. G.
Balant, V. E.
Balas, P. S.
Balcaen, R. G.
Balch, E. C.
Baldwin, G. O.
Baldwin, H. A.
Baldwin, J. E.
Ball, G. H.
Ball, J. S.
Ball, M. J.
Ballard, R. W.
Balough, C.
Bancroft, H. M.
Bankwitz, F. E.
Barasch, M. V.
Baratta, F. A.
Barker, A. R.
Barker, J.
Barkley, W. J.
Barlow, W. V.
Barnes, F. S., Jr.
Barnes, P. P.
Barnes, R. W.
Barnett, A. G.
Barrett, G. A.
Barrett, J. C.
Barron, W. J.

Barrows, R. E.
Barry, A. G.
Bartgis, J. E.
Barthel, C. E., Jr.
Barusch, L.
Basil, A. S.
Basolo, D. J.
Bastian, C.
Bates, H. L.
Batsel, M. C.
Batson, R. A.
Batt, S. J.
Bauer, G. J.
Baum, L. G.
Bauman, P.
Bayer, W. L.
Baylor, R. E.
Beach, G. L.
Beachler, D. G.
Beaith, F. B.
Beal, H. C.
Beall, C. F.
Beall, R. W.
Beard, J. I.
Bearden, W. R.
Beardsley, H. S.
Beasley, W. A.
Beatty, C. C.
Beatty, D. C.
Beatty, T. R.
Beaty, S. H.
Beaudine, D. M.
Beaumont, J. M.
Bebb, D. M.
Beck, L. G.
Becker, D. J.
Becker, R. F.
Becker, W. J.
Beckley, H. E.
Bedrosian, A. D.
Beebe, H. G.
Beede, F. E.
Behm, F. E.
Behm, L. F.
Behn, S.
Bekeris, L. J.
Belgin, H. H.
Bell, C. M.
Bell, E. D.
Bell, H. W.
Bellare, D.
Belock, H. D.
Bendick, P.

Ben-Haroche, G. D.
Benish, M.
Benjamin, D. C.
Bennett, L. S.
Bennett, M. D.
Benning, W. F.
Benson, C. M.
Benson, V. H.
Bent, J. G.
Bentley, A. Y.
Benton, J. R.
Berard, M. A.
Bergman, J.
Bergman, R. W.
Berhalter, J. J.
Berigan, L. G.
Berner, R. C.
Berner, R. C.
Bernstorf, R. B.
Berman, H. O.
Berry, D.
Berry, G. E.
Berry, J. B., Jr.
Berry, R. F.
Berhalter, J. J.
Berhalter, V. J.
Bertie, C. E.
Bessey, W.
Best, F. C.
Best, J. L.
Bethune, J. L.
Bettis, E. L.
Betts, A. L.
Beverage, H. H.
Beyer, F.
Beyer, H.
Bickelhaupt, C. O.
Bichkardt, A. F.
Biehn, J.
Bierwirth, F. W.
Biggert, E. F.
Biggs, O. H.
Binns, J.
Birrell, H. A.
Biser, M. H.
Bishop, L. M.
Bivins, A. C., Jr.
Bjorseth, E. A.
Black, G. A.
Black, H. S.
Black, J. M.
Black, K. C.
Black, P.

Black, R. T.
Blackmon, R. F.
Blair, C. M.
Blake, E. B.
Blake, O.
Blake, F. B.
Blakely, W. N.
Blakeman, J. H.
Blakeslee, E. M.
Bland, L. I.
Blankenship, G. H.
Blanton, A. J.
Bleakney, R. G.
Blencoe, S. G.
Bliley, F. D.
Bliss, E. G.
Blizard, J. R.
Bloecker, V., Jr.
Bloom, J. D.
Bloom, S.
Bloomberg, M.
Bloomfield, T. V.
Blue, E. R.
Board, J. A.
Boardman, W. K., Jr.
Boatright, B. C.
Bobe, C. P.
Bobela, M.
Bobzean, E. H.
Bodine, C. C.
Bodkin, C. E.
Boege, F. G.
Bogart, W. J.
Bohn, J. T.
Bois, R. L.
Boland, J. N.
Boland, W. J.
Bolen, F.
Bolenius, W. C.
Boll, O. R.
Bollin, W.
Boltz, J. B.
Bolvig, L.
Bond, B. B.
Bond, E. D.
Bond, H. V.
Bonk, J. A.
Bonner, J. S.
Bonner, D. T.
Booe, J. M.
Booth, J. R.
Booth, O. T.
Borders, L. S.
Boren, E. V.
Boren, H. A.
Borgeson, C. A.
Borgia, A. W.
Borman, A. K.
Bornholdt, J. N.
Boross, A.
Boruszak, N.
Bosworth, E. R.
Boudreau, C. J.
Boule, G. A.
Bourgeois, A. J.
Bowie, R. G.
Bowen, A. T., Jr.
Bowen, A. E.
Bowen, R. G.
Bowers, M. C.
Bowman, C. H.
Bowman, W. T.
Bowyer, L.
Boyd, J. C.
Boyd, P. W.
Boyer, M. D.
Boyle, B.
Bozell, H. V.
Bozenstrse, D.
Bracken, S.
Brackett, C. A.
Bradbury, J. G.
Bradshaw, H. D.
Bragg, C. H.
Braly, E. B.
Brand, C. S.
Brandenburg, R. L.
Brandt, M. M.
Branstetter, H. D.
Branum, C. F.
Brass, E. A.
Braswell, C. P.
Braun, L.
Braun, W. L.
Brazell, W. J.
Brecher, W.
Breeding, C. S.
Breitenback, P.
Brengel, D.
Brengle, R. T.
Brenke, F. W.
Brereton, G. H.
Bressler, J.
Briant, C. J.
Bridges, J. D.
Bridgman, D. S.
Briggs, A. F.
Briggs, S. M.
Brigham, R. L.
Brindel, J. R.
Bristol, R. W.
Brittain, J. F.
Brittingham, L. W.
Brittingham, R.
Britton, C. C.
Brock, A. J.
Brockel, H. W.
Brockman, H. D.
Brockschmidt, J. H.
Brodie, G. H.
Brogdon, W. M.
Bromberg, E.
Bromell, R. G.
Brooke, R. G.
Brooks, A. F.
Brooks, F. E.
Brophy, F. J.
Brosky, M. J.
Brousseau, R. J.
Brown, A. F., Jr.
Brown, A. L.
Brown, A. L.
Brown, B. C.
Brown, C. A.
Brown, C. B.
Brown, C. E., Jr.
Brown, C. J.
Brown, C. W.
Brown, D. L.
Brown, F. P.
Brown, H. M.
Brown, H. R., Jr.
Brown, J. M.
Brown, J. W.
Brown, K. R.
Brown, M. D.
Brown, M. E.
Brown, O. K.
Brown, P. D., Jr.
Brown, R. G.
Brown, R. N.
Brown, S. D.
Brown, W. R.
Brown, W. R.
Brown, W. T.
Browne, B. R.
Brownfield, L. B.
Broyl, J. H.
Bruer, G. A.
Brundige, L. J.
Bruner, L. L.
Bruner, W. M.
Brunet, M.
Bryan, D. J.
Bryan, W. L.
Bryant, J. R.
Bryce, C. S.
Bryon, W. B.
Buckak, K.
Buchanan, G. C.
Buchanan, J. B.
Buck, L. L.
Buck, V. K.
Buckley, F. J.
Buckman, J. M.
Bucknell, W. H.
Bucy, L. W.
Bucy, R. T.
Budd, W. H.
Buddine, L.
Budelman, F. T.
Buford, J. C.
Buhrer, P. M.
Bullard, R. H.
Bullen, C.
Burcky, C. W.
Burch, B. M.
Burden, B. C.
Burdette, J. C., Jr.
Burdsal, A. J.
Burgevin, P. L.
Burglund, W. P.
Burke, A. L.
Burke, C. T.
Burke, F. L.
Burke, H. E.
Burke, M. G.
Burleigh, J. A.
Burns, W. C.
Burt, A. E.
Burwell, H. W.
Buser, O. C.
Bush, A. L.
Buswell, F. L., Jr.
Butchcoe, J. A.
Butler, C. H.
Butler, E. W.
Butler, H. H.
Butler, R.
Buttner, H. H.
Buzerak, J. F.
Byrnes, H. J.

Cabral, J. R.
Cadwell, C. S.
Cahill, F. E., Jr.
Caldwell, C. M.
Caldwell, E. F.
Caldwell, F. T.
Caldwell, O. H.
Calidonna, D. J.
Callaghan, E. J.
Call, G. R.
Callahan, H. R.
Callahan, J.
Callahan, L. D.
Callahan, S. E.
Camillo, M.
Campagna, A. P.
Campbell. D. L.
Campbell, E. A.
Campbell, R. E.
Campbell, E. R.
Campbell, J. A.
Campbell, M. E.
Campbell, R. E.
Campeau, R. J.
Canatella, A. R.
Candler, M. A.
Candler, W. H.
Cane, D. B.
Capace, C. F.
Cappelleti, J. M.
Card, C. L.
Cardineau, A. G.
Carfolite, E. D.
Carloss, H. W.
Carlson, A. B.
Carlson, L. C.
Carlson, R. E.
Carlsten, C. A.
Carpenter, F. H.
Carpenter, G. W.
Carpenter, H.
Carpenter, V. E.
Carreker, J. F.
Carrington, P. W.
Carroll, H. S.
Carros, C. J.
Carter, D. H.
Carter, G. S.
Carter, R. C.
Carter, R. S.
Carter, W. T.
Carto, W. J.
Case, N.
Casey, C. H.
Cashman, J. H.
Castellini, N. R.
Caswell, R. A.
Catlin, A. B.
Cattilini, E. E.
Catucci, H. G.
Cauble, G. B.
Cauger, A. V., Jr.
Cavanaugh, G. M.
Cavanaugh, S. P.
Cave, J. S.
Cavenaugh, D. E.
Cawley, W. H.
Cerwin, S. S.
Ceserani, F. L.
Chadwick, M. P.
Chaffee, D. L.
Chaikin, M.
Challenner, A. P.
Chaloupka, R. J.
Chamberlin, J. F.
Chamberlin. M. H.
Chambers, R. C.
Chan, W. W.
Chapin, W. A.
Chapman, F.
Chappell, A. R.
Chappell, J. F.
Chappelle, R. J.
Chaput, C. L.
Charles, O. G.
Charters, G. A.
Chase, R. L.
Chatten, L. J.
Cheeks, J. A.
Child, T. M.
Chow, H. M. W.
Chrisman, E. L.
Christaldi, P. A.
Christian, H. C.
Christianson, H. R.
Christianson, L. F.
Christofk, R. R.
Christy, H. A.
Cisler, S. A.
Claiborne, W. C.
Clancy, G. C.
Clancy, W. E.
Clark, A. E.
Clark, C. A.
Clark, C. T.
Clark, D. P., Jr.
Clark, E. M.
Clark, E. T.
Clark, J. J.
Clark, R. L.
Clark, T. N.
Clark, T. H.
Clark, V. M.
Clarke, N. F.
Clattenburg, T.
Clay, C. L.
Clay, W. A. L., Jr.
Cleaves, H. H.
Clema, J. M.
Clement, E.
Clements, C. C.
Clements, M.
Clifton, W. R.
Clutts, C. E.
Cluver, H. J.
Coates, P. G.
Code, J. A., Jr.
Coffey, J. W.
Coffey, R. T.
Cogswell, R. H.
Cogswell, W. P.
Cohen, A.
Cohen, L. R., Jr.
Cohen, V. K.
Cole, H.
Cole, W. M., Jr.
Coleman, B. H.
Coleman, C. T.
Coleman, J. M.
Coleman, W. R.
Colin, A. C.
Coll, J. F.
Coller, L. C.
Collett, L.
Collins, A. A.
Collins, A. F.
Collins, H.
Collins, S. P.
Colon-Tirado, J. I.
Colpitts, A. L.
Colton, R. B.
Conace, F.
Conger, E. W.
Conklin, C. E.
Conley, H.
Conlisk, R. L.
Connelly, L. A.
Connor, G. C.
Conrad, H. S.
Conrad, V. A.
Conrey, P. L.
Conte, T. M.
Converse, C. W.
Conway, E. W.
Cook, C. L.
Cook, E. F.
Cook, E. P.
Cook, L. R.
Cooke, W. T.
Cool, P. E.
Cooley, A. G.

Cooley, G. F., Jr.
Cooley, V. E.
Cooper, A. B.
Cooper, A. F.
Cooper, G. M.
Copeland, R. S.
Copley, W. M.
Coppock, E. S. C.
Corbin, R. M.
Corbin, R. T.
Corderman, W. P.
Cordill, A. A.
Corey, E. A.
Corkwell, O. J.
Corona, J. G.
Corput, R. V. D.
Corrigan, J. P.
Cosgrove, E. F.
Cosgrove, T.
Costello, J. F.
Cotell, R. D.
Cottle, G. T.
Cottony, H. V.
Cottrell, A.
Coulson, F.
Courtenay, J. A.
Cousins, S. B.
Cover, E. C.
Cowan, D. L., Sr.
Cowgill, F. A.
Cox, B. R.
Cox, C. P., Jr.
Cox, G. S.
Cox, J. F.
Cox, R. T.
Coyne, J. J.
Craft, L. M.
Craig, C. F.
Cramer, R. E., Jr.
Crane, A. S.
Crane, F. E.
Cranna, J. F., Jr.
Crapo, F. M.
Crapo, I. A.
Craven, C. L.
Crawford, A. A.
Crawford, H. C.
Crawford, J.
Creacy, C. J.
Creighton, R. R.
Creutz, J. H.
Crigler, J. R. B.
Criss, D. E.
Crist, J. A.
Crockett, D. P.
Crockett, J. I.
Cronin, F. J.
Crosby, M. G.
Crosland, E. B.
Cross, F. L.
Croston, W.
Crow, H. H.
Crow, H. H., Jr.
Crowell, G. F.
Crump, J. L.
Cruse, A. W.
Cummans, W. W.
Cummings, B.
Cunningham, J. O.
Cunningham, J. R.
Cunningham, T. P.
Cuny, C. D.
Cuphaver, C. A.
Cupp, E. W.
Curley, J. R.
Curry, P. R.
Cusack, J. N.
Custer, C. B.
Cutler, J. F.
Czajkowski, M.

Daffron, C. E.
Dahlin, O.
Daigre, S. G.
Dakin, H.
Dakin, M. H.
Dakin, W.
Daley, J. G.
Dallmer, R.
Dalton, R.
Daly, P. J.
Damerow, W. G.
Damkroger, S. F.
Dana, S. W.
Daniel, A. F.
Daniels, H.
Daniels, H. N.
Dansby, R. E.
Dant, D. M.
Dante, S. P.
Darrow, W. C.
Datres, E. B.
Daum, H. W.
Davenport, P. B.
David, C. D.
David, L.
Davidson, C. E.
Davidson, S. B.
Davies, R. C.
Davis, G. T.
Davis, H. L., Jr.
Davis, F. W.
Davis, J. E.
Davis, J. W.
Davis, S. S.
Davis, V. M.
Dawson, R. B.
Day, P. C.
Deacon, M. L.
Deady, W. W.
Dean, B. H.
Dean, D.
Deardorff, L.
DeBuys, H. B.
DeCamp, R. T.
Dedman, L.
Deeley, P. M.
Deets, J. L.
Deisinger, D. A.
Dejur, H.
Dejur, R. A.
Delaney, F. R.
Delano, A. W., Jr.
DelCamp, S. M.
DeLisle, J. T.
Deloraine, E. M.
Del Riccio, L.
Del Sordo, M.
Demarest, F. F.
De Marr, J. D.
Demboski, H.
Dempers, P. H.
Denkhaus, W. F.
Denner, W. J.
Derr, R. J.
DesPortes, C.
Dessauer, J. H.
Deuber, C. H.
DeVore, C.
Dewey, C. B.
Dewey, W. S.
DeWitt, J. H., Jr.
DeWitt, R. H.
DeYoung, A. E.
Diamond, A. E.
Dible, H. J.
Dickinson, T. W.
Dickson, D. D., Jr.
Dickson, D. P.
Diebold, B. A.
Dietrich, C. F.
Diggs, V. A.
Dill, R. B.
Dillard, H. H.
Dinion, N.
Disney, R.
Disser, C. J.
Ditmars, W. E.
Divine, W. H.
Dixon, G. P.
Dixon, J. A.
Dixon, R. W.
Dmochowski, T. L.
Doctor, R. C.
Dodge, A. O.
Dodge, R. I., Jr.
Dodge, W. A.
Doellner, L.
Doernback, W.
D'Olier, H.
Doll, E. B.
Doll, F. J.
Dominick, J. B.
Donat, L. W.
Dondes, S.
Donely, C. C.
Donnell, P. S.
Donnelly, N.
Donzel, A. A.
Doolittle, H. D.
Dorsey, J. S.
Dorsey, L. A.
Dorsey, W. R., Jr.
Dougherty, E. T.
Dougherty, J. P.
Douglas, W. D.
Dow, J. B.
Dow, J. M.
Dow, P. C., Jr.
Downing, J. J.
Downs, W. W.
Doyal, W. E.
Doyle, W. J.
Drach, H.
Dragsten, P.
Drake, F. K.
Drake, H. H., Jr.
Drane, W. L.
Draper, P. J.
Dreifke, E. H.
Drew, J. L.
Drinkard, H. V.
Driscoll, J. A.
Droste, G. T.
Drotts, J. D.
Droz, B. H.
Drummy, T. T.
Drury, J. L.
Dryden, K. A.
Dubes, R. F.
Dubilier, W.
DuChatellier, R.
Duff, L. M.
Dugan, H. J.
Dugan, P. F.
Duke, R. A.
Dukes, E. F.
Dumas, H. S.
Du Mont, A. B.
Dunaway, H. E.
Dunbar, R. B.
Duncan, R. L.
Duncan-Clark, C. G.
Dunlap, A. L.
Dunlap, J. H.
Dunlap, O. E., Jr.
Dunlap, R. E.
Dunn, L. J.
Dunn, R. J., Jr.
Dunn, T. J.
Dunn, T. J., Jr.
Dunning, O. M.
Dupree, J. E.
Duran, A. E.
Durant, W. G.
Durst, N. J.
Durst, R.
Durst, R. W.
Duryee, P.
Dutschman, K. T.
Dutton, W. P.
Dvorsky, A. L.
Dwyer, C. R.
Dylewski, T. J.

Earls, H. G.
Eason, R. K.
Eason, W. H.
Eberly, C. W.
Ebling, W. F., Jr.
Eckley, F. R.
Echols, J. M.
Eckersley, J. W.
Eckert, J. M.
Eder, M. J.
Eddy, D. W.
Edmonston, A. L.
Edmonston, A. S.
Edwards, D. F., Jr.
Edwards, R. G.
Edwards, W. C.
Edwards, W. H.
Ege, W. M.
Eggert, J. H.
Egli, J. J.
Ehle, H.
Ehrgott, W.
Eichbaum, J. H.
Eichhammer, A. A., Jr.
Eide, R.
Eigelbach, R. B.
Eilers, O. A.
Elder, R. L.
Elder, E. V.
Ellefson, B. S.
Ellenberger, R. M.
Elliott, A. M.
Elliott, R. E.
Ellis, W. A.
Ellis, W. H.
Elliston, F. A.
Ellner, P. H.
Elser, F. J.
Eltz, G. J.
Elward, N. K.
Elwell, R. G.
Emery, F. L.
Emrey, E. B., Jr.
Endress, C. H.
Engel, F. H.
Engelson, H. R.
Engh, H. M.
England, C. D.
Engler, L. R.
Engstrom, E. W.
English, D. A.
Enoch, G.
Entwistle, G. R.
Epstein, B.
Erb, W.
Erikson, G. G.
Ernst, A. M.
Estremski, S. F.
Evans, B. H.
Evans, C. W.
Evans, C.
Evans, E. R.
Evans, H. V.
Evans, J. J.
Evans, W. E.
Evans, W. A.
Evans, W. J.
Evans, W. T.
Evelyn, D. E.
Evenson, L. O.
Everitt, J. A.
Everitt, W. L.
Ewig, W. J. Jr.
Ewing, W. B.
Eyster, J. A.

Faige, M. D.
Fairchild, J. K.
Fairlamb, P. B.
Faithorn, W. E., Jr.
Falk, B.
Falk, B. A.
Falk, S. A.
Fallon, R. B.
Fann, H. W.
Fanning, R.
Farman, I. L.
Farnham, N. E. J.
Faulhaber, R. G.
Fay, A. H.
Fay, D. A.
Fay, F. H.
Feakins, G. H.
Feely, F. J.
Feger, G. H., Jr.
Feigus, J. I.
Feindel, W. B., Jr.
Feissner, C. A.
Feldheim, F. S.
Feldman, C. R.
Fell, C. F.
Felty, M. S.
Fenner, C. M.
Fenske, E. R.
Ferdon, E. A.
Ferguson, E. F.
Ferguson, H. A.
Fernandes, A. N.
Fernandez, J. F.
Fernandez, M.
Ferree, K. S.
Ferree, R. J.
Ferris, H. P.
Ferry, J. T.
Festner, R. H.
Fetchko, G.
Fiala, J. N.
Fidler, R. H.
Fidler, W. A.
Field, G. S.
Fields, L.
Fields, R. F.
Filiberti, G. J.
Finch, W. G. H.
Fincher, M. C.
Fingerle, W., Jr.
Finkelstein, S.
Finlay, R.
Finley, E. D., Jr.
Finley, J. D.
Finn, R. S.
Fishel, J. C.
Fischer, J. S.
Fischer, N. J.
Fisher, A.
Fisher, B. N.
Fisher, R. L.
Fisher, R. R.
Fishkin, L.
Fister, F. M.
Fitch, J. A.
Fitzgerald, J. J.
Fitzgibbon, D. J.
Fitzpatrick, F. R.
Flanders, C. K.
Flashman, J. J.
Fleischl, M. M.
Fleming, H. A.
Fleming, J. W.
Fletcher, H. E.
Fliderblum, D.
Flint, W.
Flock, K.
Flocken, L. H.
Flora, A. M.
Flora, H. W.
Flore, C. F.
Floyd, W. F.
Flynt, E. R.
Flyzik, J. A.
Foley, P. H.
Foley, R. J.
Foltz, W. E.
Fontaine, E. V.
Forbes, A. C.
Ford, B. H., Jr.
Fortin, C. G.
Fortune, E. L.
Foster, A. P., Jr.
Foster, C. L.
Foster, E. K.
Foster, H. F., Jr.
Fotiadi, N. T.
Foulkrod, R.
Fouts, B. S.
Fowler, G. M.
Fowler, W. S.
Fox, R. J.
Frabutt, A.
Fralick, D. S.
Frank, E. M.
Frank, J.
Frank, O. A.

Frank, R. B.
Franz, W. J.
Franzoni, F. R.
Fraser, G. B.
Frawley, J. J.
Frech, R. L.
Fredenburg, A. M.
Frederick, B. J., Jr.
Freed, A.
Freehafer, C. R.
Freeman, D. W.
Freeman, R. L.
Freeze, R. C.
Freimann, F.
French, D. K.
Frendreis, J. J.
Freret, L. D.
Friar, E. M.
Frick, S. W.
Fried, M.
Fried, R. K.
Friedman, M.
Friend, H. C.
Friend, H. H.
Fritz, E. G.
Fritz, W. H.
Frizelle, T. E.
Freuler, J. R.
Froke, L. C.
Frost, H. H.
Fry, A.
Fuchs, W. N.
Fuller, A. G.
Fuller, B. L.
Fuller, G. R.
Fuller, M. W.
Fulsher, H. D.
Fullwood, R.
Fulton, J. H.
Funk, C. H.
Fussell, L.
Fuqua, H. G.

Gadler, S. J.
Gaeckle, W. H.
Gaither, J. F.
Gaither, L. E.
Galbraith, J. L.
Gale, T. R.
Galins, E. W.
Gallagher, H. T.
Gallagher, L. O.
Gallaher, K. S.
Galloway, D. I.
Galone, A. N.
Galt, J. E.
Galusha, M. E.
Galvin, P. V.
Galvin, R. W.
Gambrill, R. D.
Gammell, L. W.
Ganly, G.
Gannon, W. J.
Ganteaume, P. A.
Gantt, J. A.
Garbellano, D. W.
Garlow, R. W.
Garner, G. D.
Garrett, E. J.
Garrett, F. L.
Garrett, L. S.
Garson, A. J.
Gartrell, R. D.
Garvey, F. A.
Gary, T. S.
Gates, F. L., Jr.
Gates, R. S.
Gauthier, V. E.
Gaynor, A. M.
Gearing, H. F.
Gedeon, J.
Gephart, G. C.
Gera, J.
Gerhan, C. F.
Gering, G. W.
German, W. J.
Gernsback, M. H.
Gerson, A.
Gerstenberger, H. L.
Gerth, J. H.
Gertsch, E. P.
Gervais, E. T.
Gessford, R. K.
Getman, G. A., Jr.
Gibbs, H. F.
Gibson, A. F.
Gibson, D. C.
Gibson, D. K.
Giers, H. W.
Gikas, G. N.
Gilardi, A. J.
Gilbarte, J. F.
Gilbert, H. L.
Gilbert, R. W.
Gilcher, V. J.
Gilfillan, S. W.
Gill, D. W.
Gill, F. M.
Gill, R. S.
Gillen, S. F.
Gillenwaters, T. R.
Gillespie, F. T.
Gillespie, J. D.
Gillette, E. C., Jr.
Gillette, E.
Gillingham, C. E.
Gilson, R. A.
Gimlick, R. W.
Girard, E. J.
Gittings, T. B.
Given, N. D.
Glass, C.
Gleason, D. I.
Gleason, I. W.
Glen, A.
Glenn, J. R.
Glenn, R. C.
Glezen, L. L.
Glover, B. H.
Godfrey, X. W.
Goetz, L. P.
Goetz, M. T.
Gogola, B. J.
Goldner, J. H.
Goldsmith, T. T., Jr.
Goldstone, G. H.
Goldwag, H.
Gollhofer, P. J.
Gonseth, J. E., Jr.
Gonzalez-Correa, E.
Gonzales, M. J., Sr.
Gooding, L. E.
Goodman, J. M.
Goodman, K. C.
Goodrich, R. H.
Goodwin, D. A.
Gootee, T. E.
Gordan, T. C., Jr.
Gordon, J. E.
Gore, T. S., Jr.
Gorham, J. E.
Gorman, H. A.
Gorman, L. J.
Gould, M. L.
Gourlay, T. B.
Graf, G. F.
Graff, H.
Graham, G. N.
Graham, H. B.
Graham, J. R.
Graham, R. W. W.
Graham, V. M.
Granfield, T. H.
Gramann, R. G.
Grammer, D. C.
Grant, J. W
Graver, R. A.
Graves, L. E.
Gray, N.
Gray, R.
Grayson, J. D.
Green, C. H.
Green, C. V.
Green, G. M.
Green, H. R.
Green, J. H.
Green, L. F.
Greene, A. H.
Greene, F. C.
Greene, G. G.
Greene, M.
Greer, E. M.
Greer, W. R., Jr.
Gregorski, W. J.
Gregory, F. A.
Gregory, J. G.
Gregory, J. E.
Greulich, R. A.
Grieling, W. R., Jr.
Griebling, E. W.
Greiner, J. J.
Griffin E. M.
Griffin, R. W.
Griffith, C. H.
Griffith, J. W.
Griffith, P. E.
Griffiths, O. H.
Grimes, W. M.
Grinerich, J. J.
Gripper, P. C.
Grisham, R. E.
Grist, R. S.
Groen, P. J.
Grohs, L. H.
Grosselfinger, W. H.
Grossman, H. W.
Groves, L. R.
Gruhn, R. S.
Grzeszyzyk, E.
Gubin, L.
Guest, W. T.
Guilbeault, G. K.
Guild, D. S.
Guill, J. E.
Gunn, D. W.
Gunnesh, R. M.
Gunning, J. G.
Gunther, K. W.
Gushikuma, M.
Gustafson, E. H.
Guthrie, F.
Guthrie, F. P.
Guthridge, P. F.
Gwin, J. A.
Guyot, G. V.

Haag, V. L.
Haas, M. L.
Haase, G. R.
Hackerman, I. N.
Hackett, A. P.
Haefling, B. J.
Hafmeister, E. F., Jr.
Hagan, J. V., Jr.
Hagan, R. G.
Hagar, K.
Hagberg, C. R.
Hahn, C. C.
Haight, J. D.
Haines, E. G.
Haining, L. E.
Haire, C. D.
Hale, M. M.
Hall, Amma N.
Hall, E. C.
Hall, F. W.
Hall, G. B. H.
Hall, L. G.
Hall, W. G.
Hall, W. W.
Hallahan, W. L.
Hallenbeck, F. J.
Halligan, W. J.
Halloran, T. F.
Hamilton, E. A.
Hamilton, J.
Hamilton, W. A.
Hamlin, W. D.
Hammond, E. W., Sr.
Hammond, E. F.
Hammond, G. F.
Hammond, J. W.
Hanan, J. P.
Hancock, D. W.
Hancock, N. F.
Handleman, M.
Handy, J. V.
Hanigan, P. A., Jr.
Hankins, S. H.
Hanna, R. C.
Hanna, V. K.
Hannah, G. M.
Hansen, H. M.
Hansen, R. W., Jr.
Hanson, H. J.
Hanson, M. L.
Hanson, O. B.
Harback, H. D.
Harcarik, A. J.
Hardy, E. J.
Harenberg, J. C.
Hargrave, T. J.
Harhay, A. J.
Harlow, F. G.
Harmon, C. C.
Harmon, R. N.
Harnett, J. B.
Harney, E. C.
Harp, J. A.
Harper, J. F.
Harper, R. B.
Harrington, W. H.
Harris, C. R.
Harris, F. W.
Harris, J. D.
Harris, M.
Harris, M. D.
Harris, R. F.
Harris, W. M.
Harrison, C. M.
Harrison, W. H.
Harsh, H. C.
Hart, A. L.
Hart, N. L.
Hart, S. F.
Hart, W. M.
Hartley, S. H.
Hartman, J. A.
Hartman, W. T.
Hartz, J. E.
Harvey, C. C.
Harwood, A.
Hascall, R. S.
Haskell, H. L.
Hass, C. W.
Hassinger, A. K.
Hausheer, H. D.
Havens, J. F.
Hawkins, J. F.
Hawkinson, F. G.
Hawks, T. H.
Hawthorne, A. S.
Hawthorne, A. K.
Hay, A. B.
Hayes, E. K.
Hayes, H. G.
Hays, W. V.
Hayward, W. A.
Healey, W. M.
Healy, G. W., Jr.
Healy, J. P.
Healy, W. J.
Hearn, R. B.
Heart, E. C.
Heatwole, J. W.
Hebb, A., Jr.
Hebb, E. E.
Heberton, K. W.
Hector, L. G.
Heil, J. B., Jr.
Heinrich, J. E.
Heitmueller, R.
Helm, H. P.
Helme, M. B.
Helsel, D. M.
Helton, B. W.
Hemion, J. R.
Hemmrich, F.
Hemphill, J. E.
Hempstead, D. E.
Henderson, R.
Henderson, R. G.
Henderson, R. W.
Hendrickson, M. M.
Hennessey, T. M.
Hennig, W. J.
Henricks, G. H.
Hensel, W.
Hepler, J. W.
Herbert, R. E.
Herbst, C. S.
Herget, G. H.
Herman, F. A.
Herold, F. O.
Herpich, G. I.
Herr, R. F.
Herrelko, F. E.
Herring, T. A.
Herrlein, W. R.
Herrmann, H. W.
Herrmann, F. R.
Herron, A. M.
Herron, R. A.
Hertsche, J. C., Jr.
Hertzel, R. W.
Herzberg, D. H.
Herzog, E. F.
Hester, L. C.
Heston, C. E.
Heuck, R.
Heuline, C. G.
Hewitt, W. J.
Heyler, H. W.
Heymann, A. S.
Hickey, R. A.
Hicks, L. C.
Higbee, C. W.
Higgins, E. R.
Higgs, J. E.
Hildreth, R. C.
Hill, C. C.
Hill, D. R.
Hill, J. N.
Hill, L. W.
Hill, L. E.
Hill, R. G.
Hill, S. S.
Hilliard, D. M.
Himmel, R. N.
Hinemon, J. H.
Hines, J. G.
Hinshaw, F. A.
Hirsch, G.
Hirsch, J. D.
Hitchcock, G. W.
Hitchcock, H. W.
Hitzenhammer, A. D.
Hobson, J. L.
Hockensmith, W. A.
Hodges, C. C.
Hodges, D.
Hodgkiss, J. T.
Hodson, A. E., Jr.
Hodson, H. S.
Hoffman, H. J.
Hoffman, H. L.
Hoffman, N. R.
Hoffman, R. M.
Hoffman, W. O.
Hoeflick, C. J.
Hogan, R. D.
Hogg, J. L.
Hogge, W. E.
Hogle, A. F.
Hohmann, A. C.
Hoke, A. S.
Holcombe, H. C.
Holdam, J. V., Jr.
Holdcraft, J. M.
Holland, S. E., Jr.
Hollander, W. V.
Holloway, O. L.
Holloway, W. W.
Holly, K. R.
Holmes, A. W.
Holmgrain, B. E.
Holritz, C. A.
Holshouser, E. L.

Holst, W. L.
Homrighous, J. H.
Homsher, M. A.
Hood, J. T.
Hope, T. W.
Hopkins, J. S.
Hopley, R. J.
Horbach, S.
Horn, F. C.
Hornak, P. M.
Horne, C. F., Jr.
Horner, A. A.
Horney, L. G.
Horowitz, J.
Horsey, E. J.
Horst, A. W.
Hort, H. J.
Horton, H. E.
Horton, R. A.
Horvath, J.
Hosken, R. T.
Hough, A. R.
House, C. A.
Houston, E. C.
Howard, C. B.
Howard, C. M.
Howard, H. P.
Howard, J. M.
Howell, L. L.
Howell, R. L.
Howland, J. R.
Hoyt, R. L.
Huarisa, J. B.
Hubbard, B. R.
Hubbard, J. G.
Hubbard, L.
Hubbard, W. H.
Huber, G. H.
Hudson, L. J.
Huebler, M. A.
Huffman, K.
Huffman, L. M.
Huggins, C. N.
Huggins, R. C.
Hughes, H. C.
Hulick, H. M.
Hulit, C. E.
Hull, D. R.
Hunt, A. S.
Hunt, G. C.
Hunter, H. V.
Hunter, J. W.
Hupalo, W.
Hurlbut, H. D.
Hurley, B. C.
Hurley, J. E.
Hussey, E. G.
Hutchins, D.
Hutchinson, J. S.
Hutchinson, R. W., Jr.
Huth, L. G.
Hyde, R. H.
Hyman, H.
Hyman, H.

Iannelli, S.
Iller, J. A.
Ingalls, P. H.
Inge, B.
Ingersoll, B. W.
Ingerson, K. E.
Inglis, W. G.
Inman, H. T.
Insull, S.
Irby, V. C.
Iropeano, M. C.
Irwin, D. D.
Iskowe, I.
Izard, B. P.

Jablon, W. W.
Jacks, S. T.
Jackson, B.
Jackson, R. W.
Jacobsen, E. A.
Jacobsen, H. W.
Jacobsen, O.
Jacobson, A. F.
Jacobus, W. L.
Jacocks, F. G., Jr.
James, J. E.
James, M. B.
Jamison, W. H.
Janes, C. W.
Jaquith, L. M.
Jarmie, T. W.
Jarmon, W. R.
Jarvis, G. B.
Jaszczult, T. P.
Jeavons, H.
Jeffcoat, S. E.
Jeffers, G. T.
Jenkins, A. L.
Jenkins, D. E.
Jenkins, J. G.
Jennerson, H. L.
Jennings, C. B.
Jennings, H. M.
Jennings, N. E.
Jennings, W. E.
Jensen, A. C.
Jensen, C. H.
Jentzen, W. H.
Jernigan, R. F.
Jervey, W. W.
Jess, G. H.
Jett, E. K.
Jewell, G. A.
Jewett, R. B.
Johantgen, R. F.
John, F. J.
Johns, J. N.
Johnson, C. H.
Johnson, E. A.
Johnson, E. W.
Johnson, E. C.
Johnson, G. C.
Johnson, H. E.
Johnson, H.
Johnson, H. W., 3rd
Johnson, J. Kelly
Johnson, J. P.
Johnson, K. L.
Johnson, L. E.
Johnson, M. R.
Johnson, M. S.
Johnson, M. A.
Johnson, O. K.
Johnson, P. H.
Johnson, R. L.
Johnson, R. M.
Johnson, W. B., Jr.
Johnston, C. E.
Johnston, C. J.
Johnston, G. F.
Johnston, R. S.
Johnston, W. H.
Jones, A.
Jones, C. V.
Jones, E. L., Jr.
Jones, F. C.
Jones, H. V.
Jones, H. E.
Jones, L. R.
Jones, L. W.
Jones, M. G.
Jones, P. K.
Jones, R. B., Jr.
Jones, S. W.
Jopling, J. P.
Joseph, J. J.
Joy, C. R., Jr.
Joyce, W. T.
Jucius, S.

Kaden, E.
Kahler, W. V.
Kahmer, L. V., Jr.
Kaiser, G. B.
Kalas, A. J.
Kale, L. W.
Kaleel, E. M.
Kalisch, B.
Kamin, V. A.
Kane, A. P.
Kaplan, M.
Kaplowitz, M.
Kappel, F. R.
Kaprelian, E. K.
Karhuse, C. A.
Karpovich, J.
Kaska, W. N.
Kaslan, A. E.
Katz, E. M.
Kauffman, C. D.
Kaufman, J.
Kavanagh, R. S.
Kawahara, R. H.
Kaye, G. W.
Keane, W. J.
Kearney, H. B., Jr.
Kearney, R. F.
Keawe, J. K.
Keffer, D. S.
Kegehein, H. A.
Kelleher, C. A.
Keller, F. P.
Kelley, W. A.
Kellison, L. A.
Kellogg, J. H.
Kelly, J. W.
Kelly, R. P.
Kelly, W. P.
Kelly, W. A.
Kelsey, J. E.
Kemon, J. P.
Kemp, E. M.
Kemp, L. C.
Kemper, H. W.
Kempton, J. A.
Kennard, S. R.
Kennedy, R. M.
Kent, E. E.
Kent, M. D.
Kenworthy, C. H.
Kenworthy, F. H.
Keown, G. W.
Keplinger, J. C.
Kercher, M. A.
Keresey, H. D.
Kern, G. F.
Kerncamp, M. W.
Kerr, F. W.
Kerr, G. L., Jr.
Kerr, J. B.
Kerr, M. F.
Kerr, W. A.
Kershaw, J. R.
Kershner, S. W.
Keyser, F. D.
Kiblinger, Wm. H.
Kidwell, F. E.
Kiebach, C. D.
Kilgo, M. M.
Kilgo, W. H.
Kilgore, R. R.
Kilgour, B. L., Jr.
Killigrew, D. L.
Killingsworth, H. T.
Kimball, B.
Kimball, R. E.
Kimbrough, J. M., Jr.
Kincaid, J. B.
Kinert, J. O.
King, C. J., Jr.
King, E. S.
King, L. A.
King, L. S.
King, M. E.
King, P. S.
Kingsbury, J. W.
Kinley, N. J.
Kinney, J. R.
Kleiman, F.
Klein, A.
Klein, J. C.
Kleinau, C. S.
Kleinknight, L. R.
Kleinschmidt, E. E.
Kleinschmidt, E. F.
Kleinwachter, B. R.
Klosterman, C. W.
Knell, R. L.
Kneyse, W. A.
Knezo, J., Jr.
Knoll, V. B.
Knowles, W. K.
Knox, H. E.
Kobick, H. G.
Koch, C. C.
Koch, H. R.
Koch, K. J.
Koch, S. J.
Koehler, J. F.
Koenig, E. P.
Koenig, E. L.
Koenig, W. A., Jr.
Koerner, E. A.
Koerner, R. C.
Koester, W. T.
Kolar, A.
Kolar, E. F.
Kolata, W. S.
Kolb, E. R.
Kollin, J. L.
Kolodziej, P. R.
Komoroske, A. B.
Komoroski, J. R.
Kopicki, A. J.
Koppes, L. M.
Kopriva, C. P.
Korchin, B.
Kornblith, L., Jr.
Kornstein, S.
Koss, I.
Kotsch, H. A.
Kouba, J. W., Jr.
Kovacevich, M. M.
Kowalski, S. M.
Kramer, W. E.
Kranz, F. W.
Kranz, V.
Kranz, W.
Kraus, P. T.
Krawczyk, N. J.
Krebs, V. G.
Krehbiel, I. F.
Krieger, G. E.
Kressler, D. R.
Kretlow, S. A.
Kronke, C. J.
Krueger, C. F.
Krueger, R. C.
Kryter, R. J.
Ktistes, P. J.
Kucera, J. H.
Kuepfer, W. C.
Keusel, F. H.
Kuhn, H. A.
Kuhn, J. P.
Kuhn, R. H.
Kult, M. L.
Kunkel, G. L.
Kurosawa, T.
Kurth, E. H.
Kurtz, R. S.
Kussart, J. P.
Kuvallis, J. N.
Kyne, T., Sr.

Lack, F. R.
Lackey, H. B.
Lacy, R. E.
Lacy, T. N.
Lader, R.
Lafler, H. A.
Lain, G. S.
Lake, N.
Lamb, G. B.
Lamb, H. M.
Lambdin, A. L.
Lambert, A. W.
Lambert, J. A.
Lambert, K. B.
Lamkin, L. J.
Lanahan, F. H., Jr.
Lance, R. R.
Land, G. R.
Landgraf, T. H.
Landmesser, J. B.
Landwehr, R. L.
Lane, G. T.
Lang, H.
Langenbeck, K. H.
Langley, A. W.
Lanphear, C. A.
LaPointe, F. A.
Larsen, C. L.
Larson, R. H.
LaSalle, G. W.
Lascaris, J. L.
Lassen, V. H.
Latta, W. J., Jr.
Lattin, J. D. B.
Laudeman, T. W.
Laurendine, C. E.
Laux, R. E.
Lavoie, S. D.
Lawlor, R. D.
Lawlis, L. L.
Lawrence, C. D.
Lawrence, G. R.
Lawrence, W. T.
Lawton, K. B.
Laycock, H.
Lazar, E. F.
Lea, J. W.
Leahy, W. A.
Leas, J. W.
LeBedda, J. M.
LeDrew, J. H.
Lee, D. C.
Lee, R. N.
Leeman, W.
Leeds, H. S.
LeFavour, L. G.
Legwen, G. W.
Lehman, H. J.
Leib, F. E.
Lello, H. F.
Lemoine, L. H.
Lengefeld, F. R.
Lenigan, D. G.
Lentz, J. R.
Lenzner, E.
Leonard, A. A.
Leonard, J. A.
Leonard, R. L.
Lepore, A. L.
Lerner, G. P.
Lesser, F. A., Jr.
Lester, C. J.
Letts, M.
Leuteritz, H. C.
Levi, I. J., Sr.
LeVino, R. B.
Levy, H. K.
Lewis, A. O., Jr.
Lewis, G.
Lewis, J. R.
Lewis, L. J.
Lewis, M. T.
Lewis, R. E.
Lewis, T. H. A.
Lewis, W. P.
Lichtenberger, W. H.
Lilienfeld, J.
Lilly, H. D.
Lind, C. W.
Linderman, L. E.
Lindsay, W. W.
Lindstrom, L. G.
Ling, E. F.
Lingle, W. H., Jr.
Link, E. O.
Link, F. M.
Lipe, E. B.
Lipkowitz, J. J.
Lippincott, D. K.
Liput, J. A.
Lisanti, D. C.
Liseman, W. F.
Littell, E. L.
Little, D. C.
Little, D. G.

Little, Murray A.
Littlefield, T. R.
Littlejohns, A.
Litvak, A. M.
Litz, W. P.
Liuni, F.
Livingston, R. D.
Lloyd, H. H.
Lobata, E. J.
Lobeck, R. A.
Lochard, G. M.
Lockhart, N. B.
Lockhart, R. M.
Lockhart, W. L.
Lockwood, A. C.
Loeb, F. M., Jr.
Logan, W. R.
Loizeaux, P. F.
Lokey, G. A.
Long, F. H.
Long, J. H.
Long, K. B.
Long, R. J.
Long, W. B.
Longfellow, H. R.
Longstreth, J. C.
Loomis, R.
Loop, W. H.
Lorch, V. H.
Lord, G. H.
Lord, R.
Lorrison, C. E.
Lotz, W. E., Jr.
Love, L. R.
Lowe, J. A., Jr.
Lowry, H. H.
Lowry, J. R.
L'Roy, R. E.
Lubera, J. S.
Lucas, J. F.
Lucas, L. L.
Lucas, V. M.
Ludden, C. F.
Luginbuhl, H. R.
Luichinger, M. J.
Lukeman, W. T.
Lundberg, A. O.
Lundberg, O. W.
Lyle, G. A.
Lyman, F., Jr.
Lyman, R. P.
Lyncy, V. T., Jr.
Lyons, O. I.

McAlea, G. J.
McAteer, R. H.
McCabe, C. C., Jr.
McCall, L. C., Sr.
McCall, R. F.
McCann, G. R.
McCann, R. C.
McCann, T. A.
McCarter, S. W.
McCarthy, C.
McCarthy, E. A.
McCarthy, J. F.
McCarty, C.
McCarville, A. J.
McClung, J. A.
McClure, D. F.
McClure, H. B.
McClusky, W.
McConaughy, J. G., Mrs.
McConnell, K. R.
McCorkle, E. E.
McCorkle, P. H.
McCormack, F. J.
McCourt, A. W.
McCoy, E. K.
McCoy, H. K.
McCoy, J. M.
McCoy, J. W.
McCrary, A. A.
McCrory, E. L., Jr.
McCullagh, G. H.
McCulloch, H. J.
McCullough, J. F.
McCullough, J. I.
McCullough, P. M.
McCurdy, H. L.
McCurdy, R. B.
McDavid, J. A.
McDonald, H. D.
McDuffee, C. B.
McElroy, R. J.
McElwain, C. W.
McFarland, K. D.
McFarlin, F. E.
McGalliard, A., Jr.
McGinnis, N. F.
McGovern, J. J., Jr.
McHugh, K. S.
McIntyre, J. C.
McIntyre, W. J., Jr.
McIver, H. A.
McKay, D. E.
McKeever, D. A.
McKendry, J. J.
McKenney, C. A., Jr.
McKenna, T. J.
McKenzie, C. H.
McKenzie, H. K.
McKenzie, T. H.
McKim, K. W.
McKinney, R. D.
McLaughlin, C.
McLaughlin, R. L.
McLean, J. D.
McManus, W. J.
McMicken, C. R.
McMillin, R. R.
McNally, G. J.
McNeil, W. H.
McNish, K.
McPheeters, W. D.
McPherson, J. B.
McPherson, L. G.
McQuown, F. T.
McQuown, M. P.
McRae, J. W.
McTernan, W. R.
Maas, W. M.
Maben, E. T.
Mabry, A. W., Jr.
Mabry, F. S.
Mabry, J. H.
MacAllaster, W.
Macarow, F. G.
Macarow, J. C.
MacDonald, G. R.
MacDonald, H. N.
MacDonald, J. R.
MacDonald, W. A.
Macewicz, J. C.
MacFadden, W. C.
MacGougan, F. H.
MacGregor, J. R.
Machlett, R. R.
Mack, W. M.
MacKenty, J. G.
Mackerman, J. L.
MacLafferty, J. W.
Madden, J. E.
Maddoz, H. R.
Madigan, J. P.
Madigan, W. A.
Madonick, L.
Maedel, G. F.
Magee, W. L.
Magin, J. G.
Magnuski, H.
Maguire, J. J.
Maher, E. T.
Mahoney, W. H.
Main, J. W.
Major, T. W.
Maliniak, J.
Malnight, J. D.
Malone, S.
Maloney, R. W.
Malsbary, J. S.
Manaseri, B. B.
Mandelbaum, A. J.
Manly, C. H.
Mann, P. J.
Manning, C. D.
Mansfield, W. H.
Mapes, R. H.
March, K. F.
Marcy, A. R.
Marcy, H. L.
Marcus, S. G.
Margolies, H.
Markel, M. L.
Marker, M. R.
Marks, P. S.
Marks, W. S., Jr.
Marsh, B. R.
Marsh, C. J.
Marsh, E. G.
Marshall, G. A.
Marshall, W. P.
Martin, A. D., Jr.
Martin, E. T.
Martin, J. E.
Martin, K. F.
Martin, P. M.
Martin, R. W.
Martin, S. A.
Marts, H. H.
Martsolf, C. M.
Marston, F. F.
Mascuch, J. T.
Maskell, D. A.
Maslin, R. S., Jr.
Mason, C. F.
Mason, C. F.
Mason, E. B.
Mason, H., Jr.
Mastin, P. W.
Matejka, J. V.
Matherne, J. R.
Matheson, R. M.
Mathis, J. B.
Mattes, H. C.
Matthews, C. L., Jr.
Matus, J.
Maude, R. C.
Mauer, M. G.
Mawhinney, A. S.
Maxcy, E. C.
Maybeck, W. W.
Mayer, D. V.
Mayer, J. F.
Mayer, W. S., Jr.
Maynard, P. C.
Mayoral, G. A.
Mead, E. E.
Meade, T.
Meade, M. T.
Meader, G. S.
Mearls, W. J.
Medaris, J. E.
Meeds, W. E.
Meehan, J. A.
Meek, P. D.
Meeker, E. D.
Meese, C. W.
Mehring, J. S.
Meier, R. A.
Meinken, K. C.
Mellen, E. R.
Mellen, W. J.
Melling, R. E.
Melvin, G. H., Jr.
Menagh, F. H.
Menkee, W. R., Jr.
Meola, E. A.
Mercer, P. V.
Merkel, H. E.
Merle, L. V., Jr.
Mero, P. G. S.
Merrill, E.
Messer, H. G.
Metcalf, E. F.
Meth, J. B.
Metzeroth, F. C.
Meuer, G. A.
Meyer, J. H.
Meyer, L. H.
Meyer, R. G.
Meyers, J. M.
Mezger, G. R.
Michie, R. W.
Mickelsen, A. E.
Mickelson, E. O.
Middleton, W. W.
Mielziner, O. H.
Milbouer, J. A.
Miles, J. H.
Milk, A. L.
Millard, R. P.
Miller, A.
Miller, B.
Miller, B. T.
Miller, D. B.
Miller, E. E.
Miller, F. N.
Miller, F. G.
Miller, G. V.
Miller, H.
Miller, J. D.
Miller, J. H.
Miller, L. W.
Miller, P. T.
Miller, P. M., Jr.
Miller, R. B.
Miller, R. W.
Miller, S. W.
Miller, S. A.
Miller, W. T.
Miller, W. C.
Milligan, C. G.
Milligan, G. M.
Milliken, C. M.
Mills, J. V.
Minatoya, R. J.
Minckler, R. W.
Minehan, F. J.
Miner, W. M.
Mirras, P. W.
Misener, G. C.
Mitchell, A. J.
Mitchell, A. K.
Mitchell, E. F.
Mitchell, F. W.
Mitchell, G. S.
Mitchell, J. C.
Mitchell, L. J.
Mitchell, M. R.
Mitchell, T. H.
Mittanck, E. H.
Mizell, M. H.
Mizrahi, J.
Mizuno, H. J.
Mock, C., Jr.
Moeller, L. J.
Mogavero, C.
Mohardt, P. L.
Mohr, A.
Mohrmann, R. J.
Moir, W. W.
Molesky, W. F.
Montague, H. R.
Moody, M. S.
Moody, W. H.
Moon, H. F.
Moore, C. F.
Moore, E. D.
Moore, F. A.
Moore, F. L.
Moore, H. W.
Moore, H. N.
Moore, L. R.
Moore, J. T.
Moore, T. J.
Moore, T. J.
Moran, A. I.
Moran, E. E.
Moran, F. E.
Moran, R. B.
Moreland, H. D.
Moreland, H. D.
Morgan, M. J., Jr.
Morgan, N. J.
Moritz, M.
Morley, A. R.
Morrel, W. G.
Morrell, G. A.
Morrill, P. R.
Morris, E. T.
Morris, F. W., Jr.
Morris, G. W.
Morris, J. G.
Morris, R. W.
Morris, W. M.
Morris, W. F., Jr.
Morrison, J. A.
Morrison, J. B.
Morrissey, E. L.
Morrow, J. K.
Morton, R. S.
Moses, J. G.
Moses, W. G.
Mosier, J. C.
Moskowitz, I. L.
Mosely, W. K.
Moss, S. A.
Mowrey, G., Jr.
Moynahan, G. F., Jr.
Mueller, E. L. P.
Mueller, F. W. H.
Mueller, W. L.
Muir, W. A.
Mullaney, J. H.
Muller, E. W.
Muller, J. H.
Mulliken, W. C.
Mundy, R. F.
Munich, F. E.
Munson, C. E.
Munson, L.
Munson, N. S.
Murphy, C.
Murphy, C. A.
Murphy, C. E.
Murphy, G.
Murphy, L. W.
Murphy, W. E.
Murray, G. A.
Murray, N. J. M.
Murray, P.
Murray, P. F.
Murray, R. R.
Musson, C. H.
Muter, L. F.
Muth, H.
Myers, G. E.
Myers, J.
Myers, J. E.
Myers, L. J.
Mylod, J. A.

Naab, M. P.
Nakamura, D. K.
Nangle, W. O.
Narland, S. C.
Nash, J. F.
Nason, D. B.
Nathness, S. T.
Nattress, M. G., Jr.
Nauck, D. A.
Naudascher, W. H.
Neal, P. L.
Neary, E. J.
Needham, P. J.
Neely, G. M.
Neiswinter, J. T.
Nelson, A. R.
Nelson, C. J.
Nelson, D. H.
Nelson, J. W., Jr.
Nelson, R. T.
Nelson, A. R.
Nenzel, P. N.
Neth, J. E.
Nettleton, J. S.
Neubauer, E. C.
Neubauer, R. A.
Neubauer, W. C.
Neuenschwander, K. C.
Neumann, H. H.
Nevill, W. C.
Neville, D. H.
Newcomer, M.

Newhouse, A. B.
Newlin, D. A.
Newton, C. L.
Nicely, W. A.
Nichols, C. V.
Nickel, J. R.
Nickerson, F. C.
Nielson, M. I.
Niemi, A. N.
Ninemires, C. D.
Nixon, R. J.
Nixon, W. J.
Noble, D. E.
Nolan, D. C.
Noggle, J. B.
Nolker, W. F.
Norman, R. T.
Norris, P. A.
Northrop, E. D.
Nowicki, E. B.
Nutt, C. E.
Nutt, J. D.

Obermiller, R. M.
O'Brien, F. J.
O'Brien, T. F. F.
O'Brien, W. J.
O'Callaghan, J. J.
O'Connor, R. A.
Odarenko, T. M.
O'Day, J.
O'Donnell, J. F.
Oehlsen, J. L.
Oeser, L. G.
Oestermeyer, C. F.
O'Grady, F. T.
Ohlson, C. J.
Ohm, E. F.
Ohnemus, P. M.
O'Keefe, D. P.
Oken, N.
Oldfield, H. R.
Olesen, H. L.
Olin, C. L.
Oliver, B. H.
Oliver, F. F.
Oliver, H. R.
Oliverson, L. M., Jr.
O'Loughlin, T. J.
Olschner, E. W.
Olsen, O. N.
Olson, D. R.
Omberg, A.
O'Meara, W. F.
Opie, S. P.
Opitz, H. B.
Oppenheim, B. J.
O'Pray, R. F.
O'Reilly, R. A.
O'Reilly, W. P.
Orlan, T.
Ormond, D. L.
Orraca, R. A.
Orton, J. T.
Osborne, E. R.
Osborne, H. F.
O'Shea, J. G.
Osterhoudt, T. G.
Otstot, R. E., Jr.
Ott, E. B.
Ott, J. J., Jr.
Ottinger, J. W.
Ottinger, L. T.
Otto, C. A.
Oye, O. C.

Pachynski, A. L.
Packard, G. C.
Page, C. W.
Page, D. J.
Page, E. C.
Pagel, J.
Paige, J. H.
Palik, T. J.
Palmer, G. H.
Palmer, D. R. G.
Palmquist, M. L., Jr.
Panek, J. M.
Panoff, J. E.
Paolozzi, T.
Pappas, H.
Paquette, H. L.
Paradis, J. F.
Paradise, E. M.
Paradise, M. E.
Parent, R. J.
Parent, V. A.
Park, H. A.
Park, H. A.
Parker, A. S.
Parker, D. E.
Parker, G.
Parker, H. L.
Parker, J. F., Jr.
Parker, L. H.
Parker, R. D.
Parker, S. R.
Parker, W. E.
Parkhurst, B. A.
Parnell, J., Sr.
Parrish, E. A.
Parrott, J. A.
Parsons, F. M.
Parsons, L. C.
Parsons, T. W.
Parsons, W. S.
Partridge, A.
Paschal, A. D.
Patrick, P. J.
Patterson, J. N.
Patterson, W. C.
Patteson, H. L.
Patton, R. G.
Patueau, E. G.
Pavlat, R. A.
Paxton, O.
Payne, V. F.
Pearce, J. M.
Pecci, A. C.
Peck, J. H.
Pederson, E. L.
Peel, W. L.
Peltier, J. C.
Penas, F. D.
Pence, W. P.
Pendleton, G. H.
Penick, A. P. M.
Penuel, V. B., Jr.
Peoples, M. O.
Peppos, M.
Perdue, L. P., Jr.
Perkins, H. H.
Perkins, O. D.
Perkins, S. H.
Perley, A. L.
Perrin, W. K.
Persing, J.
Perry, R. S.
Peters, D. W.
Peters, E. P.
Peters, J. R.
Peters, M. K.
Peterson, T. F.
Petroff, P. A.
Petrou, N. V.
Petrov, A.
Petzing, E. R.
Pfannstiehl, S.
Phelps, D. J.
Phelps, J. M.
Phillips, C. W.
Phillips, J., Jr.
Phillips, R. C.
Phillips, W. H.
Phoebus, J. W.
Pieklik, W.
Pierce, A. T.
Pierce, H. J.
Pierce, W. T.
Pierson, G. L.
Pikus, H.
Pilliod, J. J.
Pinsky, E. J.
Pinsley, M.
Pinsley, N.
Pinsley, S.
Plashko, E. B.
Plass, C. E.
Plummer, W. E.
Plunkett, H.
Pochyla, B. H.
Pohl, J. A.
Poff, J. K.
Polk, A. B.
Polkinghorn, F. A.
Pollitt, W. J.
Pollock, R. D.
Pomeroy, P. S.
Ponce de Leon, B.
Ponder, S.
Pool, E. J.
Pope, E. T., Jr.
Pope, T. N.
Popkess, G. E., Jr.
Porter, G. V.
Porter, G. W.
Porter, H. E.
Porter, J. D.
Porter, N. E.
Porter, R. S.
Potter, M. L.
Pottinger, R. L.
Powell, C. L.
Powell, F. P.
Powell, W. F., Jr.
Powers, J. W.
Powers, S. J.
Pratt, H.
Pratt, W. V., Jr.
Preisman, A.
Prendergast, L. J.
Prentice, R.
Prescott, R. D.
Preston, D. M.
Prestwood, J. G., Jr.
Previn, S. W.
Prewitt, D. W.
Price, D. W.
Price, D. L.
Price, M. B.
Price, R. R.
Prideaux, G. F.
Prina, F.
Pritzker, L.
Proper, A. F.
Protzman, C. W.
Prows, D. L.
Pruner, H. M.
Pryor, T. S.
Pufahl, E. R.
Pugh, J. F.
Puleo, A.
Pulsifer, A.
Pumphrey, F. H.
Purdy, T. A.
Purinton, R. W.
Putnam, T. R.

Quackenbush, E. C.
Quanrud, O. G.
Quarrier, F.
Quashnock, E. J.
Quatman, G. B.
Quick, C. E.
Quigley, Q. S.
Quinn, D. J., Jr.
Quinn, V. G.
Quisenberry, B.

Rachanow, L. L.
Radcliffe, J. G.
Radford, R. R.
Radsch, R. W.
Radwanski, M.
Raff, H. B.
Rahm, A. M.
Rahner, H. B.
Ramirez, T.
Ramsay, R. E.
Ramsey, C. C.
Ramsey, M. A.
Randall, R., III
Randall, B. O.
Raney, M. C.
Ranft, W. Q.
Ranger, R. H.
Rankin, A. I.
Rankin, M.
Raschke, W. M.
Rasmussen, A. O.
Rasmussen, E. L.
Ratliffe, M. D.
Raty, R.
Raudenbush, D. H.
Rauland, E. N.
Ray, C. S.
Raynsford, R. W.
Read, C. A.
Read, H. N.
Read, O.
Reading, L. M.
Rearden, J. R.
Reaser, R. L.
Rector, I. G.
Redd, T. L., Jr.
Reddick, W. J.
Redfield, D.
Reed, B. S.
Reed, C. E.
Reed, H. L.
Reed, J. V.
Reed, R. B.
Reed, R. W.
Reeder, G. W., Jr.
Reeder, W. O.
Rees, E. H.
Reese, S. W.
Reeves, C. P., Jr.
Reeves, H. V., Jr.
Reichelderfer, H.
Reidy, G. B.
Reidy, P.
Reilly, E. L.
Reilly, F. C.
Reiman, B.
Reinhard, F. G.
Reinsel, G. R.
Reiss, L.
Remich, J.
Remmlein, C. D.
Remon, J. A.
Rende, A. A.
Renhard, J. A.
Renstrom, J. E.
Reynolds, E. R.
Reynolds, F. M.
Reynolds, H. L.
Reynolds, K. E.
Rhine, F. W.
Rhoades, H. W.
Rhodes, W. H.
Rhodes, W. H.
Rhodes, W. H.
Rice, H. W.
Rice, J. E., Jr.
Rich, G. H.
Richards, G. E.
Richards, J. A. K.
Richards, R. T.
Richardson, D. W.
Richardson, H. W.
Richardson, W. M.
Richey, L. M.
Richey, C. R., Jr.
Rickards, W.
Rideout, E. W.
Rider, G. W.
Rider, J. E.
Rider, J. F.
Ridgway, H., Jr.
Rierson, G. D.
Ries, E. C.
Ringer, M. C.
Ringson, W. R.
Rinkenbach, R. R.
Rippon, S. G.
Risen, E. L.
Rita, J.
Ritchie, C. M.
Ritter, E. E.
Ritter, E. W.
Ritter, L. J.
Rizzo, L. J.
Roach, A. K.
Robb, J. S.
Robberson, R. L.
Robbin, L.
Roberts, J. N.
Roberts, W. E.
Robertson, J. H.
Robertson, S. B.
Robinson, A. W., Jr.
Robinson, C. S.
Robinson, E. M.
Robinson, F.
Robinson, H. H.
Robinson, M. G.
Robinson, R. C.
Robinson, S. J.
Robinson, S. A.
Roche, J. M.
Rochlitzer, C. B. B.
Rockar, W. F.
Rod, L. S.
Roder, C. C.
Roderick, R.
Rodgers, J. M.
Rodriquez, R. A.
Roe, H. R.
Rogers, A. W.
Rogers, E. F.
Rogers, H. H.
Rogers, H. H.
Rogers, L.
Rogers, W. J.
Rokaw, L.
Roley, S. J.
Rollins, L. H.
Romano, V. J.
Rooks, W. A.
Ropp, J. G.
Rosch, S. J.
Rose, B.
Rose, T. G.
Rosenbaum, J.
Rosenberg, A.
Rosenberg, J. M.
Rosenbloom, R.
Rosenthal, H.
Ross, A. H.
Ross, A. M.
Ross, D. M.
Ross, J. M.
Ross, L. J.
Rosser, S. P.
Rothman, I. R.
Roup, R. R.
Rourke, E.
Rous, W. H.
Roth, M. S.
Rowe, H. N.
Rozanski, J. F.
Ruark, A. E.
Ruben, S.
Rubenstein, M.
Rubin, M. A.
Rubinroit, H. M.
Rucker, J. J.
Rudd, M. C.
Ruddell, A. G.
Rudesill, E. F.
Rudiger, C.
Ruehl, G. C., Jr.
Ruhl, R. J.
Rumbough, W. S.
Rumsey, A. L.
Runkle, S. C.
Rupard, M. B.
Rush, F. N.
Rushing, R. O.
Russ, L. J.
Russell, H. V.
Russell, J. B.
Russell, J. H.
Russell, K. B.
Ryan, J. C.
Rykert, G. L.

Ryan, S. R.
Ryerson, W. I.
Ryder, E. A.
Ryles, L. Y.

Saari, L. V.
Sack, S. L.
Saibara, R.
St. Clair, O.
St. Clair, W. K.
Salas, C.
Salkind, H.
Saltus, F. N.
Saltzman, C.
Salz, I. F.
Salzmann, C. E.
Samiljan, J.
Sampson, C. L.
Samuels, J.
Samz, C. L.
Sanders, C. E. D.
Sandler, W.
Sandstrom, E.
Sanning, F. G.
Sapoznick, H.
Sarles, L. C.
Sattler, W. P.
Saunders, B. W.
Saunders, J. F., Jr.
Saunders, N. H.
Savacool, W. C.
Savard, G. H.
Savin, L. M.
Sawyer, A.
Sawyer, B.
Sawyer, C. H.
Sawyer, C. F.
Sawyer, C. N.
Sawyer, J. A.
Saxon, F. A.
Sayner, W. V.
Sayre, C. D.
Scales, H. N., Jr.
Scanlon, J. J.
Scarangella, N. A.
Schaal, F. J.
Schnachtel, I. I.
Schaefer, D. A.
Schafer, H. E.
Schafer, P. J.
Scharffenberger, G. T.
Schatte, A. C.
Schatz, J. P.
Schecter, J.
Schedlbauer, C. M.
Schenck, H. H.
Scheffen, D. H.
Schenck, H. H.
Scheneman, H. W.
Schiff, I.
Schildhauer, H.
Schimmel, J.
Schlegel, C. E.
Schlick, W. A.
Schleuter, N. D.
Schmeling, A. M.
Schmidt, A. G.
Schmitt, A. J.
Schmitt, C. J.
Schnable, G. L.
Schneider, A. W.
Schneider, R. W.
Schnitz, S. M.
Schnoor, H. L.
Schopper, C. A.
Schrader, A. T.
Schreiber, W. B.
Schroeder, A. H.
Schroeder, G. H.
Schroll, H. J.
Schuchard, W. F.
Schukraft, R. E.
Schulte, O. J.
Schultis, L. R.
Schultz, J. N.
Schmacher, H. A.
Schumann, L. I.
Schupple, H. L.
Schuster, C. E.
Schuster, R. G.
Schutte, W. C.
Schwartz, C. A.
Schwartz, F. J.
Schwartz, N. J.
Schwartzenberg, H. W., Jr.
Schwarz, A.
Schwarz, R. A.
Scofield, E. H.
Scofield, H. L.
Scofield, R. G.
Scott, C. L.
Scott, J. M., Jr.
Scott, G.
Scott, S. B.
Scribner, R. N.
Scroggs, J. P.
Seager, C. W.
Seaman, S. L.
Searcy, G. W.
Searing, J. W.
Sears, C. B.
Seaton, G. L.
Seaton, G. L.
Seaton, L. M.
Seay, R. L., Jr.
Seay, W. R.
Secan, F. D.
Sefing, J. J.
Segna, F. R.
Seibert, W. L.
Seip, W. H.
Selquist, R.
Selwyn, G. V.
Semel, S. J.
Semmer, F. E.
Sendelbach, L.
Seoane, C. A.
Setzer, A. L.
Sexton, J. E.
Seyster, M. E.
Shaffer, G. W.
Shaffer, L. J.
Shamray, P. L.
Sharp, W. J.
Sharp, W. J.
Shattuch, A. B.
Shaver, W. W.
Shaw, W.
Shaw, W. H.
Shea, E. T.
Shea, J. R.
Shea, T. E.
Schecklin, G. F.
Sheedy, J.
Sheehy, T. E.
Sheeley, L. R.
Sheets, R. V.
Sheldrick, R. T.
Shepard, H. W., Jr.
Shepard, W. M.
Shepherd, J. O.
Shepherd, L. F.
Shepherd, M. F.
Sheppard, H. S.
Sherman, S.
Sherman, W. E.
Sherrard, J. O.
Sherrill, S. H.
Sherron, P. H.
Sherry, B. J.
Sherwood, R.
Sheve, H.
Sheviak, F.
Shields, T. J.
Shipman, J. W.
Shoaff, W. J.
Shockley, T. R.
Shoemaker, R. J.
Short, D. E.
Short, J. A.
Shonnard, J. R.
Shotts, R. E.
Shrader, K. G.
Shrawder, W. J.
Shreve, J. E.
Shreve, T. S.
Shultz, E. A.
Shupp, F. G.
Shute, D. M.
Shute, E. R.
Sibbet, J. R.
Sica, N. A.
Sicuranza, C.
Sidur, R. A.
Siegel, H. E.
Sieger, J.
Siegfried, V.
Siemund, R. W.
Sieving, G. J.
Sigman, J.
Sigmon, L. C.
Siling, P. F.
Silton, R. J.
Silva, A. D.
Silva, T.
Silver, J.
Simon, J. H.
Simmons, G. H.
Simmons, G. M.
Simmons, V. M.
Simonds, E. A.
Simpson, A., Sr.
Simpson, G. W.
Simpson, J. H.
Simpson, S. H., Jr.
Simpson, W. A.
Singer, F. J.
Singleton, F. P.
Sinkler, C. I.
Sinnott, H. J.
Sirmyer, E. A., Jr.
Skehan, J. W.
Skidmore, H. M.
Slack, C. W.
Slack, R. F.
Slade, H. B.
Slade, W. H.
Slagle, H. J.
Slattery, W. L.
Slezak, J. A.
Slingo, H. J.
Sloan, C. C.
Sloan, R. R.
Sloat, H.
Sloope, G. L.
Slurzberg, S.
Smedley, F. H.
Smith, A. L.
Smith, C. E.
Smith, C. W.
Smith, C. D.
Smith, C. U.
Smith, D.
Smith, E. D.
Smith, E. C.
Smith, E. W.
Smith, F.
Smith, F. E.
Smith, F. A.
Smith, G. G.
Smith, G. A.
Smith, H.
Smith, H. A.
Smith, H.
Smith, J. E.
Smith, J. A.
Smith, J. F.
Smith, J. S.
Smith, L. N.
Smith, M. P.
Smith, R. A.
Smith, R. J.
Smith, S. A.
Smith, S. T.
Smith, T. A.
Smith, T. H.
Smith, W. F., Jr.
Smith, W. G.
Smitha, H. L.
Smock, S. C.
Smuckler, A. F.
Snoots, W.
Snow, C. E.
Snowdon, E.
Snyder, C. L.
Snyder, L. G.
Snyder, W. C.
Sobel, A.
Sollie, S. A.
Solomon, D. L.
Sonner, E. B.
Soule, J. W.
Soules, W. F.
Spangenberg, L. F.
Sparks, S.
Sparling, W. S.
Spaulding, V. G.
Spear, W. W.
Speer, T. J.
Speir, W. A.
Spencer, L. L.
Spencer, T. H.
Spicci, M. V.
Spicer, V. T.
Spiess, G. G.
Spitz, C. E.
Sprackling, W. E.
Sprankle, D. O.
Springer, E. S.
Spurlock, F. N.
Stackpole, J. H.
Stacy, W. Q.
Staed, G. C.
Staehli, C. L.
Stafford, R. E.
Stahl, J. L., Jr.
Stalker, J. K.
Stallings, H. F.
Stammreich, I. H.
Stanat, A. E.
Stanford, L. H.
Stanley, C. E.
Stanley, F. L.
Stanton, C. A.
Stanton, J. M.
Stapleton, W. G.
Stark, R. E.
Staron, F. J.
Starr, W. F.
Staub. C. A.
Starzyk, B.
Stearns, H. M.
Stecher, H. I.
Steege, G. A.
Steen, J. R.
Steffens, E. F.
Steffens, M.
Stein, S. S., Jr.
Stein, T. G.
Steinberg, E.
Steinberg, J.
Steiner, L. E.
Steiner, M., Jr.
Stengel, J. F., Jr.
Stengel, J. F., Sr.
Stephenson, T. B.
Stern, B.
Stern, E. C.
Stevens, C. T.
Stevens, D. L.
Stevens, R.
Stewart, A. E.
Stewart, F. H.
Stewart, G. R.
Stewart, J. H.
Stewart, O. F.
Stice, K. S.
Stiehl, R. P.
Stiles, M. R.
Stillman, R. B.
Stobbart, A. J.
Stock, S. R.
Stodter, C. S.
Stoehr, S. C., Jr.
Stofer, J. O.
Stoffregen, W. E.
Stone, B. F.
Stone, E. P.
Stone, E. W.
Stone, H. R.
Stone, J. S.
Stone, L. S.
Stone, P. M.
Stopple, W. J.
Storm, E. F.
Storms, H. E.
Stout, D. F.
Stowell, A. L.
Straus, E. J.
Strauv, V. W.
Strawn, G. M.
Strike, C. L.
Stroehmer, W. G.
Stromberg, R.
Strong, G. G.
Strong, P.
Strong, P., Jr.
Strothman, T. H.
Strunk, R. W.
Stuart, J. L.
Studer, R. W.
Stull, W. H.
Stump, R. D.
Stupakoff, S. H.
Sturgeon, J. S.
Sturges, W. R., Jr.
Sturn, J. M., Jr.
Suemori, T.
Suffern, N. G.
Sullivan, S. W.
Sullo, E. T.
Sultzer, M.
Sundby, A. V., Jr.
Sunderland, P. U., Jr.
Supitilov, M. C.
Suplee, G. B., Jr.
Sur, J. D. Y.
Sussdorff, R. R.
Sutherlin, L.
Sutter, A. W.
Sutor, D. M.
Swanson, A. D.
Swanson, E.
Swanson, R. W.
Swartz, J. W.
Swatko, J. J.
Swearingen, W. A.
Swede, A. G.
Sweeney, J. W.
Sweeny, W. S.
Sweitzer, T. J.
Swinnerton, A. C.
Swift, R. G.
Swope, D. P.
Symms, M. S.
Symmes, K. R.
Sypher, C. M.

Tabor, H. E.
Talbot, W. S.
Taliaferro, M. L.
Talley, D.
Talley, E. L.
Talliman, J. J.
Tamamian, L.
Tankersley, C. E.
Tanner, A. R.
Tarpley, M. W.
Tarr, L. W.
Tasker, H. G.
Tatom, L. J.
Tawzer, W. E., Jr.
Taylor, C. E.
Taylor, C. F.
Taylor, G. E.
Taylor, G. L.
Taylor, H.
Taylor, J. P.
Taylor, H. C.
Taylor, K. A.
Taylor, M. A.
Taylor, R. I.
Taylor, W. R.
Taylor, W. J.
Taymans, B. J.

Tedrick, F. M.
Tellwright, F. D.
Temple, L. C.
Templeton, J. S.
Tennyson, L. S.
Terpay, G. A.
Terry, R. D.
Terry, S. T., Jr.
Tew, A. B.
Thayer, R. C.
Thingelstad, C. S.
Thom, E. H.
Thom, W. H.
Thomas, B.
Thomas, G. L.
Thomas, L. L.
Thomas, R. E.
Thomas, R. W.
Thomas, S. M.
Thomas, W. E., Jr.
Thompson, E. J.
Thompson, L. A.
Thompson, F. G.
Thompson, J. W.
Thompson, R. C.
Thompson, R. E.
Thompson, R. S., Jr.
Thompson, W. A.
Thompson, W. E.
Thompson, W. H., Jr.
Thomson, E. W.
Thornton, E. B.
Thornton, E. B.
Thornton, H. N.
Thorogood, B. K.
Thorpe, C. A.
Thorpe, J. R.
Thurston, E.
Thym, G. C.
Tibbetts, W. D.
Tibbs, C. C.
Tice, F. H.
Tilgate, J. T.
Tillery, R. B.
Timmons, F.
Tipton, M. F.
Tittle, N. L.
Todd, J. R.
Toft, D. O.
Tolnas, O. J.
Tomb, W. H., Jr.
Tompkins, M. M.
Tompos, S. F.
Toussaint, T. A.
Town, G. R.
Townsley, F.
Tracy, H. C.
Tradup, A.
Trafton, D. C.
Trafton, H. A.
Trainor, M. B.
Trautfelter, J. H. L.
Trautman, B. J.
Treadwell, M. S.
Tregida, A.
Tremaine, H. M.
Triem, W. R.
Trissal, J. M.
Troman, R. A.
Troutman, F. R.
Truesdale, G. H.
Tryon, J. C.
Tschache, M. H.
Tucker, L. B.
Tucker, R.
Tudor, R. N.
Tullis, H. A.
Tully, T. J.
Turner, A. L.
Turner, B. S.
Turner, C. N. D.
Turner, E. A.
Turner, F. J.
Turner, H. G.
Turner, H. R.
Turner, M. R.
Turnier, E. A., Jr.

Turpin, W. P., III
Tuttle, F. E.
Tuxworth, F. E.
Tyer, D. H., Jr.
Tyus, N. I.

Ugoletti, L. S.
Uhler, D. M.
Underwood, D. H.
Underwood, J. C.
Ungaro, G. M.
Unger, S.
Unzicker, A. E.
Upchurch, S. B.
Upton, J. D.
Urban, J. G.
Urlass, M.
Urseny, W. G.
Uslan, J.

Vail, S.
Valente, R. L.
Valenti, C. N.
VanAllen, R. C.
VanAmringe, J. D.
VanAuken, J. A.
Van Brunt, R. T.
Van Camp, F. E.
Van der Verr, J. D.
Van Deusen, G. L.
Van Duzer, A. M.
Van Harlingen, W. M.
Van Natta, C. F.
Van Schoick, J. E.
Van Trine, R.
Van Valkenburgh, R. A.
Van Voorst, M.
Van Wormer, B. F.
Van Wormer, R. H.
Varden, L. E.
Vargas, M. A.
Varner, H. A.
Vasileff, N.
Vasquez, A. B.
Vaughan, E. D.
Vawter, W. S.
Vazoulas, W.
Vea, N. D.
Vehka, T. M.
Vernam, G. S.
Vest, H. A.
Vestal, E. V.
Vickery, W. D.
Viles, F. M., Jr.
Viola, A. J.
Vitt, G. E.
Vitzthum, H. J
Vlcek, D. H.
Vogeley, W. R. Jr.
Vogt, B. O.
Voight, D. A.
Voigt, G.
Voigt, H. O.
Vollrath, B. H.
Volp, L. J.
Von Hoene, C. A.
Voorhees, E. C.
Vought, R. R.

Waaland, T.
Waber, T. V.
Wacker, A.
Waddell, C. H.
Waddingham, E. M.
Wadsworth, C. Q.
Waelde, D. C.
Wagner, C. R.
Wahlmann, R. G.
Waite, G. A.
Waite, W. H.
Waldschmidt, W. H.
Walker, A. P.
Walker, H.
Walker, L. F.
Walker, M. A.
Walker, M. A.
Wall, R. A.
Wallace, F. L.

Wallace, J. J.
Wallace, M.
Wallack, A. H.
Waller, M.
Waller, R. O.
Wallingford, J. W.
Wallis, F. B.
Wallrath, M.
Walsh, L.
Walther, C. C.
Walton, E. W.
Walz, R. F.
Wandele, F. E.
Wandling, H. D., Jr.
Wanvig, C. O., Jr.
Ward, C. A.
Ward, C. J.
Ward, J. L.
Ward, J. S.
Ward, V. H.
Wardell, W. L.
Ware, B. K.
Ware, R. B., Jr.
Warnecke, W. E.
Warren, E. S.
Warren, F. J.
Warshaw, J.
Warshow, J.
Wasser, B. W.
Wasson, E. H.
Waterman, G. S.
Waters, J. M.
Watson, C. L.
Watson, J. T., Jr.
Watson, S. R., Jr.
Watt, W. H.
Watters, J. E.
Watts, L.
Watts, M. F.
Watts, W. W.
Wavering, E. H.
Weaver, R. A.
Webb, S.
Webb, W. L.
Webber, M. W.
Weber, F.
Weber, H. H.
Weber, J.
Weber, R. E.
Wechsler, M. S.
Weed, R. M.
Weeks, E. L.
Weeks, G. E.
Weibler, C. T.
Weil, M. B., Jr.
Weill, I.
Weinberg, J. C.
Weiner, J. H.
Weiner, S. A.
Weinert, J. J.
Weinstein, M.
Weintraub, A.
Weir, D. B.
Weir, K. O.
Weisbrich, R. A.
Weiser, S.
Weisiger, C.
Weiss, F.
Weiss, G. G.
Weiss, H.
Weiss, M. V.
Weiss, R. A.
Weiss, R. O.
Welde, G. A.
Wells, H. H.
Wells, L. E.
Welsh, S. M.
Wendell, N. L.
Wenger, J. N.
Werksman, M. F.
Werner, L.
Werner, P. H.
Werthmann, F. J
West, C. P.
West, D. C.
West, J. P.
West, K. A.

Weston, C. D.
Wetmore, G. C.
Wetzel, R. A.
Wharton, A. E.
Wharton, P. C.
Wheeler, H. H., Jr.
Whitaker, G. C.
White, B.
White, J. A.
White, C. W.
White, D. B.
White, E. C.
White, J.
White, J. D.
White, J.
White, L. A.
White, M. M.
Whiting, C. R.
Whitlock, F. B.
Whitman, J. A.
Whitmer, N. L.
Whitman, A. L.
Whitmire, O.
Whitney, M.
Whitney, V. E.
Whittle, J. A.
Wickenkamp, F. W.
Widen, E. N.
Wibel, J. W.
Wickstrom, C. L.
Wiesen, D. L.
Wiesen, S. A.
Wike, D. W.
Wilckens, K. W.
Wilcox, G. F.
Wild, H. F.
Wildberg, L. K.
Wilder, G. E.
Wiley, P.
Wilken, H. W.
Wilkes, J. F.
Will, R. W.
Williams, C. E.
Williams, C. E.
Williams, D.
Williams, E. V.
Williams, G. G.
Williams, G. A.
Williams, H. A.
Williams, H. W.
Williams, H. S.
Williams, H. W.
Williams, L. R.
Williams, M. L.
Williams, N. G.
Williams, R. E.
Williams, R. M.
Williams, W. R.
Williams, W.
Williamson, E. G.
Williamson, T. L.
Williford, W. W.
Willis, J. E.
Willis, J. S.
Willis, R. E.
Wills, J. E.
Wills, H. C.
Wilson, C. L.
Wilson, D. P.
Wilson, H. S.
Wilson, J. C.
Wilson, J. H.
Wilson, L. S.
Wilson, M. H.
Wilson, R. H.
Wilson, W. A.
Wilson, W. B.
Wilt, L. E.
Wilt, T. E.
Winchester, J.
Winebrenner, V. M.
Wingren, H. M.
Winings, W. H.
Winkler, I.
Winkler, W. W.
Winn, R. J.
Winn, W. R.

Winner, L.
Winter, N.
Winthrop, A.
Wirth, H. E.
Wise, E. D.
Wise, W. J.
Wishart, R. S.
Wisniewski, S. J.
Witry, F.
Witts, M. C.
Wofford, W. D., Jr
Wofford, W. T.
Wolf, E. C.
Wolf, R. W.
Wolf, S. K.
Wolfe, E. M.
Wolfe, F. J.
Wolfe, J.
Wolff, R.
Wolfskill, J. M.
Wolitzer, P.
Wollensak, A. A.
Wollensak, F.
Wong, W. S.
Wood, C. C.
Wood, G. F.
Wood, T. S.
Wood, T. T.
Wood, V. A.
Wood. W. H.
Woodfill, J. R.
Woodman, C. M.
Woodward, W. M.
Woodward, W. R.
Woodworth, F. H.
Woodey, G. F.
Woolsey, R. J.
Wooten, R. P.
Worrell, W. P.
Worsnop, A.
Wren W. W.
Wright, A. K.
Wright, C. L.
Wright, G. B.
Wright, G. E.
Wright, H. A.
Wright, S. P.
Wronski, S. F.
Wurst, F. K.
Wyckoff, A. L.
Wyland, E. E.

Yacek, L. J.
Yates, C. J.
Yaworski, J.
Yeager, H. R.
Yingst, P. V.
Yohe, C. J., Jr.
Youmans, E. C.
Young, A. W.
Young, E. J.
Young, J. L.
Young, J. L. H.
Young, L. G.
Young, M. L.
Young, P.
Young, R. L.
Youngblut, E. E.
Youngquist, F. E.
Yount, R. H.

Zager, I.
Zahl, H. A.
Zahm, C. E.
Zammit, J. J.
Zaritsky, D.
Zarrett, G. R.
Zebley, R. P.
Zelikovitz, C.
Zeller, R. C.
Zeman, S.
Zenner, W. J.
Zeppenfeld, H. B.
Zimmer, J. W.
Zimmerman, S. C.
Zischkau, W. C.
Zitzman, K. F.
Zlabek, R. W.

NEWS—SERVICES and INDUSTRY

McClelland Heads Defense Communications-Electronics

Redman Is Navy Communications Chief

Stone Goes To Special Assignment With Joint Chiefs of Staff

The last days of August saw important assignments evolve in communications-electronics directorship in the military establishment. Major General Harold M. McClelland, USAF, was named to head the newly created post of Director of Communications-Electronics of the Department of Defense. Rear Admiral John R. Redman succeeded Rear Admiral Earl E. Stone as Chief of Naval Communications, and Admiral Stone moved on to an assignment* with the Joint Chiefs of Staff.

The new office of the Director of Communications-Electronics was "established within the Department of Defense, under the direction of the Joint Chiefs of Staff," a statement by Secretary of Defense Louis Johnson brought out, "to insure maximum economy and efficiency of military communications." The Defense Secretary's directive setting up the new office states that the director shall have no other duties except those assigned by the Joint Chiefs of Staff, and that the directorship shall be rotated among the three services normally every two years. The director will be assisted by two officers from each service,* preferably with the rank of colonel, or Navy captain, and such additional officers as the Joint Chiefs of Staff may determine to be necessary.

As director of the newly created office Gen. McClelland also assumes the chairmanship of the JCEC—joint communications-electronics committee of the Joint Chiefs of Staff—which is composed of the communications chiefs of the three services, along with other representatives.

The announcement of the Department of Defense in outlining the responsibilities of Gen. McClelland "under the authority and direction of the Joint Chiefs of Staff and with the advice of the JCEC" gave as the objectives: "Establishment and control of general policies, standards, and programs for the joint communications-electronics of the armed services. General supervision over administration and utilization of personnel and facilities of the communcations-electronics activities of the armed services. Implementation of approved plans, policies, and doctrines in this field. Coordination with the director, Armed Forces Security Agency, of all matters pertaining to security of communications of the military services. Studies to integrate and coordinate the point-to-point wire, radio, and telephone facilities of the services."

Adm. Redman attains to the Naval communications chieftaincy in the odd circumstance that his brother, Rear Admiral Joseph R. Redman had held the same post. The latter was wartime Chief of Naval Communications, and now retired is vice president in charge of engineering and plant of the Western Union Telegraph Company.

Another recent appointment in the communications-electronics field, involving Naval personnel, was that of Captain H. L. Bernstein, USN, as director of the Armed Services Electro-Standards agency. This agency works out uniform standards and specifications for components and parts of electronic-radio-communications equipments. Capt. Bernstein was formerly deputy chief of the Navy Bureau of Ships electronics division, and more recently was Naval advisor on the staff of Maj. Gen. Francis H. Lanahan, Jr., commanding general of Fort Monmouth, the Signal Corps' principal installation.

Gen. McClelland, deputy commander for services of the Military Air Transport Service at the time of his appointment to the new directorship, has been associated with Army and Air Force communications steadily since 1921 and is responsible for the development and use of many important radar and electronic devices. In the postwar years his name has become especially associated with the AACS—originally the Army Air Communications Service, and now the Air & Airways Communications Service—which during the war grew to be synonymous with aids to military flying safety, and which with its miracles of landing aid development made possible the continuous functioning of Operations Vittles, the Berlin airlift. Gen. McClelland once headed the AACS, and it became one of several services under his command when he was named deputy commander for services of MATS in June of 1948.

*Details not released at the time of SIGNALS going to press.

General

Bozell Task Group Chairman

Harold V. Bozell, president of the General Telephone Corp., has been designated chairman of a task group of the National Security Resources Board to study the requirements of the nation's telegraph and telephone communications industry in event of an emergency, it was announced August 24 by Presidential Assistant John R. Steelman, acting chairman of the NSRB.

The task group, on which will serve seven executives of the Bell System and Independent operating and manufacturing branches and Western Union, was formed out of the membership of the telephone and telegraph communications industry advisory committee to the NSRB, which was established around a year ago. The group will report to NSRB assistant director of production Leighton H. Peebles.

The other members of the task group are: Vice president F. W. Bierwith of the Western Electric Co., in charge of its telephone manufacturing division; T. S. Gary, president of the Automatic Electric Sales Corp.; executive vice president C. D. Manning of the Kellogg Switchboard & Suply Co.; vice president Fred E. Norris of the General Telephone Corp.; chief engineer Harold S. Osborne of the American Telephone & Telegraph Co.; and E. R. Wheeler, general purchasing agent of the Western Union Telegraph Co.

Mr. Gary, Mr. Bozell, Mr. Bierwith, and Mr. Manning are representatives of their companies as group members of the AFCA. Mr. Gary is also AFCA vice president for chapters.

The NSRB telephone-telegraph communications industry task group, according to the announcement of Presidential Assistant Steelman, "will look into the needs, under war conditions, of the domestic communications operating industry with special emphasis on the impact on manufacturing capacity. It also will stress needs for raw materials and reserve stocks of manufactured items to provide the service necessary in an emergency.

The announcement of formation of the task group stated:

"The assignment calls for inquiries that cover both the period during conversion when civilian orders on hand are being completed and the later period when requirements must be limited to minimum maintenance, repairs and provision of essential operating supplies. The (task) committee also has been asked to make recommendations on stockpiling of the principal materials that the industry might require."

Millikan Heads Committee

Dr. Karl T. Compton, chairman of the Research and Development Board, National Military Establishment, has announced the appointment of Dr. Clark B. Millikan as chairman and Fred A. Darwin as executive director of the Board's committee on guided missiles.

Dr. Millikan, acting director of the Guggenheim Aeronautical Laboratory, California Institute of Technology, Pasadena, California, has been a mem-

ber of the committee since its formation. He is a lieutenant commander in the U. S. Naval Reserve.

Mr. Darwin, who will direct the activities of the committee secretariat, has been with the Hazeltine Electronics Corporation, Little Neck, N. Y., since 1946. During the war he served as a Naval Reserve commander in the electronics division of the Bureau of Ships of the Department of the Navy.

AF, Navy CAA Joint Study

Through the use of existing radar systems and other electronic aids, the Air Force Directorate of Communications is engaged cooperatively with the Civil Aeronautics Administration and Naval Aviation in a program to relieve the congestion of military aircraft traffic in the vicinity of the National Airport. It is confidently anticipated that the electronic aids in which the Air Force and the CAA are especially cooperating closely will bring about a solution of this air traffic congestion situation.

Bell to Run Atomic Lab

Fred R. Lack, president of AFCA and vice president of Western Electric Company, was in Sandia, N. Mex. in July with a special team of Western Electric, Bell Telephone Laboratories, and top Atomic Energy Commission officials, to arrange for the transfer of the Sandia atomic project to the two Bell System organizations as the new contractor for the Sandia plant's operation.

Other Bell System and AEC officials handling the transfer were: from Western Electric, President Stanley R. Bracken and George A. Landry, operating manager of installations; from the Bell Labs, Dr. Mervin J. Kelly, executive vice president, and Donald A. Quarles, vice president in charge of staff, Bell Labs; and from the AEC, Brig. Gen. James McCormack, Jr., director of the division of military application.

The new operators of the Sandia Laboratory will have an important function in bridging the gap between laboratory development work and the manufacturing operations on atomic weapons. Sandia is also an important point of contact between AEC operations and the military activities relating to atomic energy.

The Western Electric Co. and the Bell Telephone Laboratories will take over the work from the University of California, which had operated the Sandia Laboratory since 1945, but had advised the Atomic Energy Commission last winter that it felt it could not continue the laboratory, in addition to its contract to operate the Los Alamos Scientific Laboratory.

The Atomic Energy Commission

stressed that because of the most important function of the Sandia Laboratory and after extensive consideration of the many complex organizational and technical problems, it "decided to ask the American Telephone & Telegraph Co. to make available to this project the full technical and managerial resources of the Bell System's developmental and manufacturing subsidiaries."

Communications Legislation

A bill introduced by Senator Ernest W. McFarland (D. Ariz.) to redesign the FCC was passed by the Senate August 9th. Providing for a thorough overhaul of the FCC's structure and procedures, the bill was first introduced in May, redrafted to meet objections and reservations which came up at hearings in mid-June, and reported out July 21st by the Senate Interstate and Foreign Commerce Committee.

On the August 9th date the Senate also passed legislation authorizing the construction and equipment of a radio laboratory building for the National Bureau of Standards which will be used in testing the effect of radio wave propagation and atmospherics, and will be of paramount importance particularly to the military services. The site of the laboratory was not specified in the bill, except that it will not be on the present grounds of the Bureau of Standards.

Some of the action provided for in the McFarland bill is as follows: The FCC staff would be divided into such number of integrated divisions as are necessary to perform the agency's job, such as Common Carrier, Safety and Special Services, and Broadcast Divisions. Salary increases would be provided for. Commissioners and top staff officials would be restricted in being employed by communications licensees after leaving the FCC. The FCC would have a review staff entirely separate from the jurisdiction of the staff chiefs engaged in prosecuting cases. Hearings of a judicial or quasi-judicial nature would be held either by the full commission or a hearing examiner, and not by individual FCC members.

With the long background of unsuccessful attempts in both houses to revise the Commission's operations and structure, Senator McFarland's efforts to produce a constructive measure to meet many of the objections to current issues which have blocked final action in the past, are regarded as outstanding. The original bill, and the revised measure, bear definite evidence of avoiding complex broadcasting issues—the same ones which have been insurmountable obstacles to Communications Act changes in the past—without departing from the distinct purpose of

No Cut Yet in Military Communications Funds

(From Telecommunications Reports)

The communications operations and communications-radio electronic equipment procurement activities of the military services will not suffer diminished funds for the 1950 fiscal year under the Senate Appropriations Committee-approved military funds bill of $14,790,380,478 in cash and contract authorizations, reported to the Senate late in August, which contained a cut of $1,058,107,000 under the House-passed measure. The communications branches of the Air Force, Army and Navy came through the Senate committee sifting of funds requested without any diminution, but this might not continue if some Senators persist on deeper slashes when the bill reaches the Senate floor.

The Signal Corps received restoration of $7,390,000 from the Senate committee in funds which had been cut by the House. This restored to the Signal Corps the full amount of the Budget Bureau-approved estimate for the 1950 fiscal year of $207,390,000. Of this amount, the Signal Corps had listed for the current 1950 fiscal year funds in the amount of $78,182,193 to carry out its supply mission. In addition, the Signal Corps sought the availability of $50 million cash to be applied to contract authorizations of the 1949 fiscal year which ended last June 30.

Of the $78 million total, there was allocated $55 million for equipment and supplies for combat organizations; $650,000 for radio and radar for Army boats; and $1.7 million for meteorological equipment. Part of the $78 million fund would be for the operation of the Signal Corps procurement and distribution system. Actually the Signal Corps would have, with the enactment of the NME appropriations bill, the largest amount of funds for communications procurement of the three armed services—around $120 million.

The $7,390,000 amount had been lopped off by the House Appropriations Committee as proper because of anticipated reductions in prices of communications-radio-electronic equipment, but the drops in prices have not materialized and it is understood the Senate body recognized this situation so that the amount was restored. (It might be noted that the Senate Committee in its report stated "the (military) services recognize the trend of declining prices but maintain that they are not able at this time to evaluate it.")

The Office of the Chief of Naval Communications had the House cut of $37,000 for salaries restored by the Senate Committee and received Senate Committee approval of a total of $645,000, the same as the Budget Bureau estimate.

The Navy Bureau of Ships' Electronics Division, according to an analysis of the Senate committee bill, will have a total of $56,782,000 allocated for communications-electronics procurement and $3,200,000 of reimbursable obligations for maintenance. The Bureau of Aeronautics of the Navy also carries funds under the measure for $15,940,000 of electronics aids to navigation and airborne radio equipment.

Analysis of the Senate committee bill and report indicated that the deep cut into the air group strength to President Truman's recommendation of 48 air groups had not affected the $115 million allocated under the House-approved bill for the communications-radio-electronics procurement of the Air Force. The equipment requirements were presented to the House Appropriations Committee by the Directorate of Air Force Communications.

The Senate committee's report, however, was understood to have contained a misconception in its statement concerning "radio communication systems" that the total sum of the five-year program of transforming the Air Force and Navy radio communication systems from very high frequency to ultra high frequency would involve a total expenditure of $1 billion. The Senate committee report declared that "the committee feels that due to the many complicated technical problems surrounding this program, the very large amount of money involved in future commitments, and the fact that the Air Force and Navy have started off on separate development of equipment for the same kind of service, the Secretary of Defense should reexamine this whole program before any 1950 funds are utilized and should include in this review any production contracts utilizing funds previously made available."

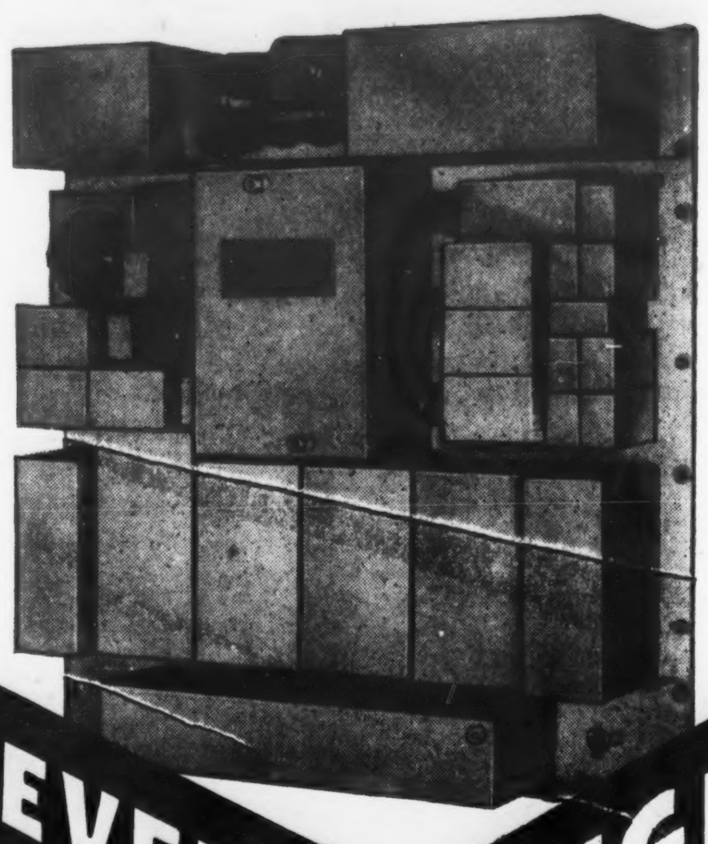
The 1950 budget contains $28 million for the UHF conversion, and of this amount $22 million is to be used by the Air Force. The Navy is understood to have spent or to have had previously appropriated $100 million, while the Air Force had only expended or received around $18 million to date.

The 1951 estimate for the Air Force expenditure in the UHF conversion is $31 million. Therefore, it is felt there has been some miscalculation of the total cost of this program, which at the most would be $500 million rather than $1 billion. The Air Force $115 million budget for electronics equipment is divided as follows: $22.93 million for UHF equipment; $10.23 million for identification electronic systems; $7.19 million for command communications network programs; $12.08 million for aids to navigation and meterological equipment; $12.96 million for tactical electronics systems; and $200,000 for communication security apparatus.

In connection with the politically-charged question of awarding military contracts to small business firms, the Signal Corps has maintained an outstanding

(*Continued on page* 54)

DEPENDABLE



FROM EVERY ANGLE ...Kellogg Carrier

NEEDS ALMOST NO MAINTENANCE

— except occasional replacement of a vacuum tube. The Kellogg Carrier is soundly designed to give trouble-free service.

REMAINS CONSTANT IN OPERATION

Built with high-quality components that resist humidity and heat, the Kellogg Carrier gives consistently dependable operation without adjustments under all conditions.

MANUFACTURER GUARANTEES PERFORMANCE

Kellogg, with years of experience in the Independent telephone equipment field, stands behind its products at all times.

EASY TO INSTALL AND ADAPT TO ALL REQUIREMENTS

All adjustments except voice and carrier output-level pre-set at factory. Mounts on any 19" rack, needs no oscillator synchronization, no frequency adjustments in the field. And the Kellogg No. 5A Carrier is designed on a flexible "unit" basis, for easy adaptation to various applications. Adding a second channel requires only a few external connections. (Models available, too, to meet every service need.)

GIVES LONG-HAUL PERFORMANCE AT SHORT-HAUL COST

The Kellogg No. 5A Carrier provides a 6db talking circuit over a circuit 30db long (measured at 11-KC). Thus, operation is possible through substantial lengths of high loss cable, such as 22-ga. exchange cable. Also, because this carrier can work over circuits which are long electrically, it does not usually require impedance matching devices for reducing reflection losses caused by junction of open wire and cable.

SAVES CONSTRUCTION COSTS, IMPROVES TRANSMISSION QUALITY

This single-channel carrier system permits transmission of two conversations simultaneously over a two-wire metallic circuit. Handles double traffic—*without* the expense of added lines, extra maintenance or heavier poles. This means a real saving, when you consider the cost of material and manpower today. Improves transmission quality too, by eliminating powerline hum.

SEND COUPON FOR FULL DETAILS TODAY!

KELLOGG SWITCHBOARD AND SUPPLY COMPANY

CARRIER

6650 SOUTH CICERO AVENUE • CHICAGO

KELLOGG SWITCHBOARD & SUPPLY COMPANY
6650 So. Cicero Avenue
Chicago 38, Illinois
Please send complete data on your carrier systems:

NAME: ____________

ADDRESS: ____________

CITY: ____________ STATE: ____________

No Cut For Communication Funds (continued from page 52)

record of placing orders with such manufacturers. In the fiscal year 1949, 28,190 contracts were awarded to small businesses, compared to 11,034 procurement actions wtih large manufacturing companies. Small business firms in these cases are defined as those employing fewer than 500 employees and as not being dominant in the industry.

the current measure. The bill as reported out is considered an important piece of work not only by Senator McFarland, the communications subcommittee which he heads, and the full Senate group, but also by Edward F. Cooper, professional staff member of the Senate committee and probably Capitol Hill's leading staff authority on communications matters.

The Interstate and Foreign Commerce Committee report noted that "this bill is the end-product of a decade of Congressional investigations, studies, hearings, and reports by committees in both houses of Congress."

New Bell Lab Directors

Vice presidents W. C. Bolenius and Bartlett T. Miller of the American Telephone and Telegraph Co. were elected Aug. 22 directors of the Bell Telephone Laboratories Inc. at a meeting of the board.

They will fill vacancies caused by the resignations of O. B. Blackwell and Keith S. McHugh. Mr. McHugh, until recently a vice president of the A. T. & T., is now the president of the New York Telephone Co. Mr. Blackwell, as assistant vice president of the A. T. & T., retired August 31 after 43 years service with the A. T. & T. and the Bell Laboratories.

Baruch at Industrial College

Bernard Baruch, far-seeing advisor of many U. S. presidents, and America's great and brilliant industrialist, delivered the graduation address at the 25th anniversary exercises of the Industrial College of the Armed Forces in Washington, June 28. General Eisenhower, a 1933 graduate, spoke briefly and Admiral Denfeld presented the diplomas to the 54 Army officers, 22 Navy officers, 34 Air Force officers and 3 Marine officers who completed the 10-months course. The names of the communications officers who graduated appear elsewhere in this issue.

Mr. Baruch took the occasion to contradict those who belittle and ridicule military men or "brass hats." He emphasized that from his close and intimate association through many years with industrialists, statesmen, politicians and military men, there is no deep cleavage between "civilians" and "military" in American life and that the good citizenship of the "brass" and "braid" is not excelled. He paid tribute to the Marshalls, the Bradleys, the Eisenhowers, Kirks, MacArthurs, Clays and other military men whose talents and genius were available to this nation to carry out such unwarlike and stupendous tasks as governing occupational zones, filling key ambassadorial posts, running huge enterprises like the Veterans Administration, and serving as Secretary of State. Military men, he has found, as a group always think of the national interest "which is more than can be said for some of their critics." He warns that while our military leaders have been able to work miracles in past wars, bringing victory to Americans who have laughed off their warnings until war actually was upon us, these leaders may not again be able to perform such wonders and we must heed their warnings and act to implement the actions they recommend.

Military Assistance Program

The four publications listed below were especially prepared by the Department of State to give the people of the United States concise factual information on the background, purposes, and provisions of the proposed U. S. military assistance program. These publications are designed to fill the different needs for information expressed in requests received by the State Department on this important foreign policy matter.

Publications listed are available without cost to organizations, groups, associations, and individuals who wish to be better informed about this development in American foreign policy.

The U. S. Military Assistance Program. Foreign Affairs Outline No. 22. Discussion of purposes and general provisions of proposed military assistance program. 7 pages.

Background Information on the Military Assistance Program. Statement by Walter S. Surrey, Deputy Coordinator for the Military Assistance Program in the Department of State. Detailed presentation of various aspects of the program with question and answer section. 15 pages.

Fact Sheet—The Proposed Military Assistance Program. Brief, concise summary of major aspects of the program. 2 pages.

Questions and Answers on Military Assistance. Selection of questions most frequently asked in connection with the military assistance program. Approximately 16 pages.

Ordnance Association

The thirty-first annual meeting of the American Ordnance Assn., a pioneer organization in the armed service-industrial relations field, was held in April at Los Angeles—the first time it has visited the West Coast. It was the first time too that the Navy had played host to the association, which has over 40,000 members, mostly civilians interested in ordnance preparedness. In addition to association president James L. Walsh and other organization officials, speakers included General J. L. Collins, Army; Admiral A. G. Noble, Navy Ordnance Chief; Maj. Gen. Everett Hughes, Army Chief of Ordnance; Maj. Gen. R. C. Coupland, Air Force armament chief; Dr. Clark Millikan, of California Tech; and others.

One exciting day was spent at sea on the carrier "Valley Forge" and other naval vessels from which the members observed a carrier-launched air strike.

Sec. Johnson at War College

The highest attainment in the Army, in the opinion of most Army officers, next to selection for appointment as a general officer, is designation to attend the War College, graduating therefrom and being detailed to the War Department General Staff. Except in isolated cases, to reach this goal an officer had to be a graduate from the one- or two-year course at the Command and General Staff School with "sufficiently high grades to be placed on the General Staff eligible list," which consists usually of only about 100 names. Those chosen to attend the College have years of "post-graduate" education in branch and other schools, wide and varied experiences, and the very finest records.

In one pre-war General Staff section, the average age of those chosen in the years 1918 to 1939 was forty-six. Most of those selected were from the combat arms, only 8 percent being from the Signal Corps and other technical services, including the Engineers. It was fitting, then, that Secretary Johnson should choose the 1949 graduating exercises of the War College as the time and the place for his first major speech on defense policies.

The class consisted of 114 graduates, including 36 Army officers, 30 Navy officers, 27 Air Force officers, 17 Foreign Service and other officers of the State Department, and one each from the Bureau of the Budget, the Treasury Department, the Central Intelligence Agency, and the Coast Guard.

The ten-month course is divided into two semesters, one devoted to the study of international relations and world affairs, and the second to the study of grand strategy.

Speaking to President Truman who was in the audience, to leaders of the armed forces, and to the graduating class, Mr. Johnson said:

"The diminished possibility of armed aggression does not nullify—or even reduce—the need for powerful military forces in the United States. Rather it multiplies the long-term importance of ready combat forces in the Army, the Navy, the Air Force. And it magnifies the need for superior personnel, mod-

ern equipment, and continuing weapon research.

"For only if American armed strength stands constantly on the political horizon, can we hope to derive maximum value from our armed forces as a long-term deterrent to war. And only so long as constancy in American military policy reassures free peoples that our moral persuasions in behalf of peace are backed by military muscle, can we expect to hold the free world's front against armed intimidation.

"Because of the weighty tax burden we represent to the American people, we in the armed forces must exert ourselves to provide honest value for the dollars we spend. The alternative to efficient and unified management of our armed forces is sacrifice by the American people of a share of their standard of living for waste, duplication, and competition among the services themselves.

"And it is here, under the roof of this establishment, that the military chiefs of all three services—as members of the joint chiefs of staff—have been invested with indivisible responsibility for the nation's security—a responsibility greatly in excess of that developing upon them as ranking officers of their respective forces.

"Thus in determining the forces that can be supported with funds available to the National Military Establishment, the joint chiefs incur responsibility not only for the combat competence of their separate services. But more important—individually and jointly—they become accountable for the sum total armed defense of the United States. For it is upon the considered military judgment of the joint chiefs of staff that the Secretary of Defense must rely for guidance.

"As Secretary of Defense, I gladly defer to the professional military knowledge of our joint chiefs of staff, and I shall not knowingly repudiate their judgment unless convinced their views are in conflict with other considerations beyond their province. For to exercise civilian control of our military institutions is not to abrogate military command but to guide it conscientiously in accord with the economic and political policies of this nation.

"Thus the primary test of our American military institution lies in its ability to exist indefinitely in peacetime as a forcible deterrent to war without militarizing the nation or bankrupting it in the ordeal. This we have sought to do by enlisting the resources of science. For in the increased destructiveness of new weapons lies our most promising prospect of achieving adequate defense without dislocation of our economy and waste of personnel in the non-productive pursuits of war.

"You gentlemen who graduate this day from the National War College have studied our security problems not from the abridged viewpoint of the service whose uniform you wear but from the wider range of our national interests. For this institution has fused into a unified concept of national security the most advanced thought of the Army, the Navy, the Air Force and the civilian agencies of our Federal government.

"More than weapons national defense is essentially a business of people. In the last analysis the security of this nation rests upon the wisdom, the judgment, the integrity, and the professional ability of people like you."

Patton and Leadership

Hal Boyle, Associated Press correspondent writing from Hamm, Luxembourg recently, demonstrates an understanding of military leadership not found often today among newspaper commentators and writers and others. He has this to say of General George Patton, whose grave is in the cemetery at Hamm:

"His legend reaches across the miles and years to all those who aspired to what he lived by, and that was leadership.

"Perhaps the word is glory. Gen. Patton used that word often. He liked the sound of it and he believed in it. He didn't fight the system under which mankind has dwelled in worry and wonder since Cain killed Abel.

"Because he spoke as bravely and straightly as he acted, he was sometimes in hot water with the American people. . . .They wanted victory and he gave it to them. There are diplomats in military as well as civilian life. Diplomats want success without the attrition and risk of gambling.

"Gen. Patton was smart enough to know that a bold general spends men's lives to save other men's lives.

To him, to die in battle for your country was the supreme glory. Gen. Patton didn't create the system, it created him.

"And until men think of glory in other terms, Gen. Patton will remain an American landmark.

"Gen Patton and his legend are world-wide—the story of courage in our time and bravery as he honored it."

AIR FORCE

A T & T and Western-Union Survey AF Communications

At the request of the Director of Communications of the Air Force, Maj. Gen. Francis L. Ankenbrandt, engineering experts of the American Telephone & Telegraph Co. and the Western Union Telegraph Co. are now evaluating the Air Force's wire communications usages within the continental United States in order to effectuate the most efficient and economical methods of operation and traffic handling.

The Air Force is desirous of improving its wire communications facilities and utilization with the latest communications methods, although the AF wire telephone and telegraph network has been known to be a highly efficient operation.

In order to bring about the best methods and procedures of handling traffic, the Air Force requested the A T & T and Western Union to assign groups of engineering and traffic experts to make the surveys. The A T & T and Western Union experts, it is understood, will examine the best methods of switching, the engineering of circuits, the methods and procedures of handling traffic and the way traffic is routed. The study, it is authoritatively disclosed, will have the goal of improving the efficiency of operations and of economy so that the Air Force can get "the most for its money" out of the appropriations designated for this functioning.

Ankenbrandt Sees UK AWS

Maj. Gen. Francis L. Ankenbrandt, Director of Air Force Communications, in his recent trip to Europe was one of the top military observers of the testing of the radar detector air-warning screen in England.

Farman Cites GC in Vittles

The heart of "Vittles" is the communications services' effort to maintain ground-plane communications and the air navigation needs, Brig. Gen. I. L. Farman, Deputy Director of Air Force Communications, emphasized in an address before 800 to 900 Signal Corps officers at Fort Monmouth. The address of Gen. Farman symbolized the extremely close relationships and cooperation between the communications branches of the military services which have unified their activities during and since the war, perhaps more than any other phase of the armed services.

There have been many remarkable communications achievements in the Berlin Airlift operations and Gen. Farman brought out that the ground control approach landings had exceeded the similar operations of all the commercial airports of the world put together. To bring down and move along the Vittles planes at an average of 3 minute intervals, and at different times one minute apart, the GC approaches had averaged 9000 a month, Gen. Farman said, and there have been actually millions of radio contacts, both message and navigation, during the operation.

A tremendous amount of communications equipment was necessary for the Airlift, Gen. Farman told the Signal Corps officers, because communications and electronic navigation aids

were so vital to the average 500 daily flights in and out of the Templehof airfield in Berlin. The frequency needs of such a communications-navigation setup as the airlift are such that the circuits must be adequate to establish instantaneously communications between planes and ground.

NAVY

Wartime Deputy Chief of Navy Communications Dies

Commodore John Vernon Murphy, USN retired, who served as deputy director of Naval Communications during World War II from 1943 to 1946, died of a heart attack July 31 at the age of 57. A 1919 graduate of the Naval Academy, Commodore Murphy had had most of his sea duty in submarines like his wartime communications chief, Rear Admiral Joseph R. Redman, USN, retired, who is now vice president of the Western Union Telegraph Co. in charge of plant and engineering. After he had completed a graduate course with a Master of Science degree at Yale University, Commodore Murphy served two tours of duty with the radio division of the Navy Department's Bureau of Engineering from 1927-29 and 1932-34. He also served as an instructor for three years at the Naval Academy's postgraduate school and was a member of several boards in the Navy Department under the Chief of Naval Operations.

USAF Using Navy Aerobees

The Air Force began firing the first of a series of 60 Navy-developed "Aerobee" rockets at the Hollaman AF Base at Alamogordo, N. Mex., Aug. 16. Some 150 to 200 pounds of electronic recording instruments will be placed in each rocket by 30 different U. S. colleges and research institutions. The firing of the rockets inaugurates a two-year program of investigating the upper atmosphere up to 75 miles above the earth. Some of the instruments will telemeter by radio reports back to the base.

Communications Appointments

Of twenty-five Navy officers selected recently for "Special Duty," eleven were designated for communications duty. They are:

Comdr. J. H. Fortune, Jr.
Comdr. D. F. Quackenbush, Jr.
Lt. (jg) H. K. Adkisson
Lt. (jg) R. N. Hughes
Lt. (jg) C. F. Peksa
Lt. (jg) H. R. Scott
Ens. D. R. Jermann
Ens. G. P. March
Ens. R. A. Marmet
Ens. E. W. Thomas
Ens. D. B. Wenger

There were no appointments for photographic duty.

The selection board was headed by Rear Adm. Frank T. Watkins. Other members were: Captains Samuel W. DuBois, James C. Landstreet, Jack S. Holtwick, Jr., John L. Collis, Robert S. Quackenbush, and William S. Post, Jr.; Commanders Alvin F. Richardson, Lloyd W. Parrish, John H. Levick, and James S. Brown.

Name	New Assignment
Saville, Gordon P., Maj. Gen.	Director of Requirements, Hq, USAF
Farman, Ivan L., Brig. Gen.	Deputy Director of Communications, Deputy Chief of Staff, Operations, Hq. USAF
Akre, Roland O. S., Colonel	Director of Communications, 311th Air Division, Reconnaissance, Topeka Air Force Base, Kansas
Bowman, Wendell W., Colonel	Director of Communications, Third Air Division, Ruislip, England
Bryan, Thomas L., Jr., Colonel	Director of Communications, Alaskan Air Command, Ft. Richardson, Alaska
Coleman, Glenn C., Colonel	Cambridge Field Station, Cambridge, Mass.
DeArmond, James K., Colonel	Chief, Plans and Policies Division, Director of Communications, Deputy Chief of Staff, Operations, Hq. USAF
Doubleday, Daniel C., Colonel	Student, National War College
Frost, Robert F., Colonel	Commanding Officer, 1804th AACS Group, Alaska
Garland, E. Blair, Colonel	Commanding Officer, 1807th AACS Wing, Wiesbaden, Germany
Graul, Donald P., Colonel	Chief, Electronics Division, Director of Research and Development, Deputy Chief of Staff, Materiel, Hq. USAF
Harrison, Charles J., Colonel	Director of Communications, Air Training Command, Barksdale Air Force Base, La.
Hayden, Gilbert, Colonel	Chief, Electronics Sub-Division, Air Materiel Command, Wright-Patterson Air Force Base, Ohio
Henry, Draper F., Colonel	Chief, Radar & Communication Requirements Section, Director of Training and Requirements, Deputy Chief of Staff, Operations, Hq. USAF
Maude, Raymond C., Colonel	Vice Commander, Air Defense Command, Mitchel Air Force Base, N. Y.
McGowan, Norman J., Colonel	Student, Air War College
Pachynski, Alvin J., Colonel	Commanding Officer, Watson Laboratories, Red Bank, N. J.
Rockey, Guy H., Colonel	Air Proving Ground, Eglin Air Force Base, Fla.
Sparhawk, George H., Colonel	Chief, Electronics Systems Division, Director of Communications, Deputy Chief of Staff, Operations, Hq. USAF
Thorpe, Charles A., Colonel	Student, Armed Forces Staff College
Wootton, Bernard M., Colonel	Chief, Communications Systems Division, Headquarters Continental Air Command, Mitchel Air Force Base, N. Y.

SIGNAL CORPS

Gen. Guest Makes Long Tour

Brig. Gen. Wesley T. Guest, Chief of the Army Communication Service Division of the Signal Corps, flew 23,000 miles in less than four weeks on his recent tour of military communications centers and facilities in Africa, the Near East and Europe. General Guest was on a most important mission on this trip in connection with the Army Communications Service and the communications of the U. S. Military Missions in these areas.

He covered Tripoli, Eritrea, Saudi Arabia, Turkey, Greece, England, France, Germany and Switzerland.

RCA, Sig Corps Conduct Tests

RCA Communications, Inc. has been given six months temporary authorization by the FCC to operate point-to-point radiotelegraph stations in the fixed public service at Kakuku, T. H., for reception and observation of RCA's Riverhead, N. Y. receiving station on the frequencies 15430, 18445 and 10397.5 kc in order to conduct frequency and time division multiplex transmission tests in conjunction with the Signal Corps.

Message Timer

According to a recent announcement by the Signal Corps, almost every message leaving the Army communication center in the Pentagon now has the sending time and the station identification included automatically by the use of a complex electrical device.

The device, invented by Syrl K. Ferguson, an engineer and former Army chief warrant officer, is designed to serve a maximum of 100 teletypewriter circuits, but by the addition of more circuits, can be enlarged to serve many more machines. It also stops and starts the transmitting machines when appropriate and, after adding the station identification and dispatch time, causes the tape to advance far enough to permit tearing between messages.

The automatic timing of military

messages is important inasmuch as it permits analysis and correction of any delays in transmission, and in addition relieves operators from the task of glancing at a clock and then making a manual notation of the time of dispatch.

Retired Officers Directory

The Chief Signal Officer has recently issued a directory in which the names and addresses of all retired officers of the Signal Corps are shown. In the foreword he points out that these officers will long remain an influence and inspiration to the entire Corps, emphasizing that on many of them fell much of the burden of "getting the message through" in the period before Pearl Harbor and the dark years early in World War II. The foreword also states that the contributions of these officers toward victory helped carve an immortal chapter of the Signal Corps record which is being compiled for the history of the Signal Corps to be published in three volumes in about two years.

Dry Battery Mob. Plan

The Signal Corps has reached agreement with manufacturers experienced in making batteries to military specifications after an exhaustive survey into the current status of the industry, which disclosed existing shortages and the required expansion to reach full wartime production schedules. Included in the survey was a computation of probable wartime requirements for dry batteries, both civilian and military, and translation of these requirements in terms of raw materials and parts.

The industry is in good shape, having expanded and modernized its facilities since World War II, the Signal Corps reported on the basis of the survey. With adequate stockpiling of materials and prompt implementation of expansion plans in an emergency the industry should have no difficulty meeting wartime requirements, it was concluded. The Signal Corps procures dry batteries for all the armed services.

SC Educational Foundation

The Signal Corps Educational Foundation was organized on 20 October 1944 and the present board of trustees is as follows:

The purpose of this organization is explained in paragraph "g" of the bylaws which states; "Said trustees shall from time to time make known to the widows of Signal Corps officers who have died while on active service, or to the guardians of children of such officers, the state and purposes of said trust-funds, and shall select, from applicants therefor, on such basis as they shall in their discretion establish, with due regard to the need of the applicants and their deserving character, children to be assisted to meet necessary expenses at any recognized college or university, and shall award such scholarships or make such gifts or loans to such children, as said funds shall permit, according to the circumstances and the discretion of said trustees; if said funds permit, said trustees may establish prizes or other awards with which to reward the achievements of those of such children who have by their scientific or literary accomplishments or by their characters as leaders among their fellows, while still enrolled in such colleges or universities, given evidence of the most notable progress in their education; if any funds remain undisposed of, said trustees may at their discretion make gifts therefrom to the Army Emergency Relief or to the American Red Cross."

There is a balance of $12,352.70 in this fund, which was accumulated by gifts from Signal Corps officer organizations, officers in various Signal Corps tactical organizations and individual Signal Corps officers.

It is the desire of the trustees that the purpose of this fund be made known to all Signal Corps officers so that assistance may be rendered in accordance with the by-laws.

Anyone desiring further information should address his inquiry to the treasurer who is located in the Office, Chief Signal Officer, Pentagon Building, Washington 25, D. C.

Signal Services Observe V-J

Carrying on a tradition that has been in effect since the end of World War II, the British Royal Corps of Signals and the U. S. Army Signal Corps exchanged greetings and toasts in the annual observance of V-J Day.

In addition to an exchange of messages between Maj. Gen. Spencer B. Akin, Chief Signal Officer, and Maj. Gen. William A. Scott, Director of Signals in London, there were ceremonies outside Russel Hall headquarters at Fort Monmouth.

A bronze plaque in memory of Signal Corps officers and men who gave their lives in the service of their country during World War II was unveiled in the main lobby of Russel Hall headquarters, as part of the post ceremony. An anniversary program followed at the Fort Monmouth Officers' Club.

Guests of Maj. Gen. Francis H. Lanahan, Jr., commanding general, included Col. John J. Duvivier of the British Military Mission to Washington, and Maj. Anthony J. Desne-Drummond, Royal British Army.

A message was sent by General Lanahan to the Commandant of the School of Signals, Camp Catterick, England, and another was received from there. Other greetings included one from the West Africa Signal Regiment.

Changes in Key Personnel

Graduates, Industrial College of the Armed Forces, June '49

To Signal Corps:
- Col. Murray Harris
- Col. Eugene A. Kenny
- Lt. Col. William E. Kaley
- Lt. Col. Timothy H. McKenzie
- Lt. Col. Jack N. Nahas
- Lt. Col. Jack E. Willis

Graduates, Armed Forces Staff College, June 1949

To Signal Corps:
- Lt. Col. Marcellus A. Kunitz
- Lt. Col. Wayne P. Litz
- Lt. Col. Aubrey R. Morley

New stations, Signal Corps

Col. G. H. Palmer, Wash., D. C., to Hq Fifth A., Chicago, Ill.

Col. J. T. Watson, Jr., Chicago, Ill., to Office Secretary of Defense, Wash., D. C.

To be students, Armed Forces Staff College, 1949-50

Lt. Col. K. Buchak, Wash., D. C., to Stu Det., Norfolk, Va.

Lt. Col. C. W. Janes, Wash., D. C., to Stu Det., Norfolk, Va.

Lt. Col. M. A. Little, Ft. Meade, Md., to Stu. Det. Norfolk, Va.

INDEX TO ADVERTISERS

BOOKS AND SERVICES

R. L. O'CONNOR, Secretary

GUADALCANAL: THE FIRST OFFENSIVE. By Dr. John Miller. GPO. $4.00.

WHEN American troops assaulted the beaches of Guadalcanal on 7 August 1942, they were embarking upon a campaign that was to become outstanding in the annals of successful American struggles against great odds. In this first offensive by American ground forces in World War II, the margin for error was perilously small, and the campaign developed into one of the longest of the war. When Gen. A. M. Patch's XIV Corps smashed the last remnants of Japanese resistance on the island in February 1943, it brought new hope to an Allied world bitter and weary from the long string of Japanese successes in the Pacific.

The Army's official history of the capture of that island is now ready for the nation. Written by a wartime Marine, *Guadalcanal: The First Offensive* gives greatest attention to ground operations, but air and naval actions are forcefully described to make clear the valuable contributions of all services to a decisive victory of the Pacific War. All relevant documents, many of which were hitherto top secret, were made available to Dr. John Miller, Jr., the author, and their contents thus appear for the first time in this volume.

This is the fourth volume of the Army's official history of the war.

THE ARMY AIR FORCES IN WORLD WAR II. University of Chicago Press. 756 pages. $6.00.

THIS volume, the second of seven scheduled, deals with the early phases of the air war against the European Axis: in North Africa, Sicily, Italy, and over occupied countries and Germany.

Early plans for a large-scale air offensive against Germany were delayed by unexpected Japanese successes in the Pacific and by German victories in Russia and North Africa. But operations from England against *Festung Europa* began with the Rouen mission of 17 August 1943 and swelled during the following year into the combined bomber offensive.

This campaign, conducted by the Eighth Air Force, was the first large-scale test of the AAF's doctrine of daylight precision strategic bombardment. Great missions like Regensburg, Schweinfurt, Marienburg, Ploesti, etc., are described in detail. There is a valuable summary listing of all the Eighth's missions before 1944.

The Allied invasion of North Africa in November 1942 forced the AAF to fight simultaneously a second war. This volume deals with the operations of the Ninth Air Force out of Egypt, of the Twelfth from Casablanca to Salerno, and with the origins of the Fifteenth. The narrative follows closely the land campaigns with which these air forces cooperated.

WASHINGTON—CITY OF DESTINY. By Alice Rogers Hager and Jackie Martin. Macmillan. 72 pages. $3.50.

WASHINGTON, capital of the most powerful representative democracy in existence, stands today at the crossroads of the world's decision. Responsibility for the future of civilization rests in a large part in the city beside the Potomac. All men ask, what manner of place is this, in which their destiny will be forged?

Washington is both a city and a symbol. The seat of our government and the home of our President, it represents the core of democracy, and from it come statements sought by lovers of peace, justice, and security throughout the world.

In this book, we see the city and its activities—all its variety and beauty. The complex workings of our government are explained. We view the city's shifting population of government officials, foreign diplomats, clerks, lobbyists, scientists, correspondents — and over a million sightseers every year. We read of the parks, stately buildings and monuments—the church where Lincoln worshiped, the Shakespeare library, the museums, and universities —all the tangible and intangible treasures of democracy.

HOW TO SERVICE RADIOS WITH AN OSCILLOSCOPE. Sylvania Electric Products, Inc. 72 pages. $1.00.

THIS 72-page instruction booklet is designed as a practical reference for radio, television and amplifier servicemen; radio operators; students; and electronic technicians.

The publication contains more than ninety diagrams, tables and schematic circuits including many waveform patterns as they appear on the face of an oscilloscope in actual service application. Text is grouped in eight chapters treating: oscilloscope fundamentals, linear time base, the complete oscilloscope, voltage measurements, radio receiver servicing, audio amplifier testing, transmitter testing, and miscellaneous applications.

Specific oscilloscope applications described include AM and FM receiver alignment, the location of hum, signal tracing, trouble shooting, identification of faults through oscilloscope pattern, checking AVC action, voltage gain measurement, auto radio vibrator tests, peak current check in rectifiers, impedance measurement, and capacitor filter check.

RADIO AT ULTRA HIGH FREQUENCIES, VOLUME II (1940-47). Edited by A. N. Goldsmith et al. Pub. by RCA Review. 485 pages. Cloth $2.50 plus 20 cents postage to foreign countries.

THIS compilation of original and reprinted papers is presented in seven sections; antennas and transmission lines, propagation, reception, radio relays, microwaves, measurements and components, and navigational aids. As additional sources of reference, the appendices include a bibliography and summaries of all papers appearing in volume I of the set.

SCIENCE AT WAR. By J. G. Crowther and R. Whiddington. Philosophical Library, 15 East 40 Street, NYC. 185 pages. $6.00.

WRITTEN for the layman as well as the scientist, this book presents an authoritative account of some of the more important aspects of the scientific contribution to the war effort. It is based on the official archives and documents assembled by the Scientific Advisory Committee to the British Cabinet. Among the basic topics dealt with are: radar, the atomic bomb, operational research, and science at sea.
Electrical Engineering.

TV RELAY MICROWAVE SYSTEM

COL. J. Z. Millar, Signal Corps Reserve Officer, has a splendid technical article

on "A microwave system for TV relaying" in the July issue of *Western Union Technical Review.* Copies will be secured for AFCA members on request. It is a timely discussion, following the article on the subject of the use of radio relays in World War II, by Maj. Gen. W. S. Rumbough in the May '49 SIGNALS, and because of the expectation that television will be a major means of transmitting intelligence in air, sea, and ground warfare of tomorrow. An article by Colonel Millar—"Telegrams on the Beam"—appeared in the January-February 1947 issue of SIGNALS.

MUST WE HIDE? By Dr. R. E. Lapp. $3.00.

A NEW book about military uses of the atom bomb. In straightforward everyday language the author explains the possibilities and limitations of atomic weapons and answers the book "No Place to Hide" reviewed in July '49 SIGNALS.

Discussion of how the bomb can be used and how it can *not* be used.

Detailed analysis of the delivery problem by latest type bombers, rockets, and other methods. New information on possible subversive warfare with atomic weapons.

Possible defenses against atomic attack — employment of radar picket fences, rocket interceptors, anti-aircraft weapons and other methods.

Written by Doctor R. E. Lapp, atomic physicist and former adviser to the National Military Establishment on problems of atomic weaponry, this book is must reading for all military personnel.

TV PICTURE PROJECTION AND ENLARGEMENT. By Allan Lytell. John F. Rider Publisher, Inc. 192 pages. $3.30.

IN the January 1949 issue of SIGNALS (pg 4) it was pointed out that the advancement of pictorial electronic communications is more and more bringing problems of photography to the communicator. Mr. Lytell's book points up a growing general recognition of the communicator's need for a knowledge of optics—a knowledge, it is predicted, that before long will be requisite for every communicator.

To give a thorough knowledge of the optical systems which are increasingly being developed in television, Mr. Lytell discusses in his book the fundamentals of light, including a historical background, and the principles of reflection, refraction, and lenses.

Included also is a discussion of refractive projection systems and those receivers now in commercial production which make use of this system. Dark-trace projection systems are discussed for the first time in a popular book. Although dark-tree systems have not as yet been developed for commercial production, experiment has shown great possibilities for their application. The present limitations and the future of television and a comparison of TV and motion pictures are presented in a final chapter.

INSIGNIA OF THE ASSOCIATION

AVAILABLE TO MEMBERS FROM THE SERVICE DEPARTMENT

The insignia of the Association in several beautiful designs and convenient styles authorized for wear by members is available at the prices quoted below. The insignia is described as follows:

The central figure is an alert powerful American eagle with strong talons clutching lightning flashes—symbolic of a strong America and national defense—especially insofar as modern communications is concerned, our basic reason for existence. The border consists of leaves of the olive branch of peace, showing that the object of military preparedness in America is to assure a lasting peace. In the background are signal flags—the first means of signalling in sea and land warfare by United States forces. Just above the eagle and between his outstretched wings is a heavy bomber in flight, symbolizing the complicated and essential communications in the Air Force, and in Naval and Marine aviation. Above that is a radar antenna array, and at the very top a radio relay antenna—for the latest major step in military communications. And none of these could exist without industry—the foundation of AFCA. In the color version there are the traditional colors of the signal flags—dexter white with red center and sinister red with white center—with a gold border to the whole.

THE ASSOCIATION MEDAL

Wrought on the medal in sharp and bold relief is the AFCA insignia. It is 1 inch in diameter. The ribbon to which the medal is suspended is of heavy grosgrain silk in orange and dark blue. Price $3.25. The medal is authorized for wear on the uniform as provided in A.R. 600-40, paragraph 52 (dated Aug. 1, 1944). Medal not available for sale to student members.

Members should take every opportunity to display AFCA insignia. The emblem worn on the uniform or civilian dress, or displayed on the wall of the home or office, carries with it an identification of distinction, is highly decorative, and helps to widen the scope of our Association by bringing it to the attention of others. The emblem is now issued in a variety of attractive forms.

LAPEL BUTTON FOR CIVILIAN WEAR

Bronze	**$1.25**	**(including tax)**
Sterling	**1.25**	**(including tax)**
10-K Gold	**4.80**	**(including tax)**

Specify whether signal flags should be in red and white enamel or plain.

MEMBERSHIP CERTIFICATES

Printed on fine diploma paper with the Association emblem in full color and the member's name engrossed.
Price $1.50.

BINDER FOR SIGNALS

Red Leatherette with Gilt Lettering

The magazines can be placed in the binder easily, in a few minutes. Each binder holds one volume of SIGNALS (issues for 1 year). This handsome, stoutly constructed, durable, imitation leather cover will preserve your magazines permanently. The name of the publication and the year of the issues contained therein will be stamped on the back of each binder.

Binders for previous years can be obtained at the same price. When ordering binders be sure to state the years desired.

EACH BINDER—PRICE $2.00

Our Book Department can furnish, in limited quantity, any book currently in print. We will also help you to secure older titles that you may need to complete your library. A 10% discount is allowed all Association members on orders of $2.50 or more except for technical books. Please indicate author and publisher where known, and allow at least three weeks for procurement and delivery. (We will place orders also for any overseas or isolated station reader of SIGNALS, but without the discount if not a member.)

TRANSFORMATION CALCULUS AND ELECTRICAL TRANSIENTS. By Stanford Goldman. Prentice-Hall, Inc. 439 pages. $8.35.

A thorough, modern, and practical discussion of transients written primarily on a subject of growing importance — development and research works in radio and engineering. All mathematics beyond calculus is developed in detail in this book.

"The principal aim of the book," Dr. Goldman says in the preface, "is to develop the methods of the Laplace transformation and its inverse for the solution of problems in electrical circuit transients."

RADAR PRIMER. By J. L. Hornung. McGraw-Hill Book Company. 218 pages, illustrations, diagrams, maps. Cloth $3.50.

OF value to those interested in obtaining a fundamental understanding of radar, this well-illustrated book presents basic principles and peacetime applications. Technical vocabulary and scientific theory are kept to a minimum. All the important areas of radar are explored, and the essential features of television, loran, and sonar are supplied.

MAGNETIC RECORDING, by S. J. Begun. Murray Hill Books. 242 pages. $5.00.

IN THE post-war period magnetic recording has made vast strides. Many manufacturers have entered this field, and sales of recorders have been substantial. To anyone interested in this field Mr. Begun's book is recommended as a thoroughly comprehensive detailing of standard and special recording devices, their features and applications.

The book brings to you a complete understanding of every detail of modern equipment, as well as its present and potential possibilities.

PAINTING WITH LIGHT, by John Alton. The Macmillan Company. 191 pages. $6.00.

ARTICLES in photography magazines on manipulating artificial light for indoor pictures are hardy perennials. But where you get it served up in small portions in those articles, the entire field is thoroughly covered in Mr. Alton's book.

Mr. Alton writes with the background of authority, for he has a long and distinguished record in Hollywood photography. His methods of lighting for photography are those of a master, and his techniques are completely detailed and illustrated in *Painting With Light.*

IF RUSSIA STRIKES. By George Fielding Eliot. The Bobbs-Merrill Company, Inc. 252 pages. $2.75.

MAJOR George Fielding Eliot is possibly the greatest simplifier of the complex problems of international relationships and war writing today. In this book he takes as his text the possibility that Russia may go to war against the Western nations in 1949. Then he develops the reasons for that possibility.

If there isn't war in 1949, what then happens? Major Eliot advances a sobering analysis:

"We cannot afford to allow the present Soviet government to come into possession of the atomic bomb plus the means to deliver atomic bombs in North America. If that eventuality approaches without any change in the structure and character of the Soviet state which would give us reassurance, then we must use our military superiority to support an ultimatum which would require the Soviet government either to enter at once into the atomic control system contemplated by the Atomic Energy Committee of the United Nations, or suffer the destruction of its atomic plants by the use of our own atomic weapons."

That seems to put Major Eliot in the "war-is-inevitable" school, or at the "war-is-practically-inevitable" school. Eventually the Russians will discover the technique of making the atomic bomb and have the aircraft to deliver it. Certainly there seems no reason to think they won't. Nor is there reason to hope that the present Soviet government will be deposed in favor of a government that would see eye-to-eye with the Western powers. And the issuance of an ultimatum such as Major Eliot suggests is, in effect, a declaration of war.

There seems to be only one answer: keep your powder dry. *Infantry Journal.*

National Best Sellers

Compiled on a Percentage Basis from the Reports of 67 Booksellers as Listed in Publishers' Weekly

Fiction

1. POINT OF NO RETURN, by John P. Marquand, *Little, Brown,* $3.50
2. FATHER OF THE BRIDE, by Edward Streeter, *Simon & Schuster,* $2.50
3. THE BIG FISHERMAN, by Lloyd C. Douglas, *Houghton, Mifflin,* $3.75
4. PRIDE'S CASTLE, by Frank Yerby, *Dial Press,* $3.00
5. 1984, by George Orwell, *Harcourt, Brace,* $3.00
6. THE BRAVE BULLS, by Tom Lea, *Little, Brown,* $3.00
7. THE TRACK OF THE CAT, by Walter Van Tilburg Clark, *Random House,* $3.50
8. OPUS 21, by Philip Wylie, *Rinehart,* $3.00
9. ELEPHANT WALK, by Robert Standish, *Macmillan,* $3.00
10. CUTLASS EMPIRE, by F. Van Wyck Mason, *Doubleday,* $3.00

Nonfiction

1. CHEAPER BY THE DOZEN, by Frank B. Gilbreth, Jr. and Ernestine Gilbreth Carey, *Crowell,* $3.00
2. THE SEVEN STOREY MOUNTAIN, by Thomas Merton, *Harcourt, Brace,* $3.00
3. PEACE OF SOUL, by Fulton J. Sheen, *Whittlesey House,* $3.00
4. BEHIND THE CURTAIN, by John *Gunther,* Harper, $3.00
5. THE GREATEST STORY EVER TOLD, by Fulton Oursler, *Doubleday,* $2.95
6. A GUIDE TO CONFIDENT LIVING, by Norman Vincent Peale, *Prentice Hall,* $2.75
7. WITH A FEATHER ON MY NOSE, by Billie Burke and Cameron Shipp, *Appleton-Century-Crofts,* $3.00
8. WHITE COLLAR ZOO, by Clare Barnes, Jr., *Doubleday,* $1.00
9. LEAD, KINDLY LIGHT, by Vincent Sheean. *Randolph House,* $3.75
10. HOW TO STOP WORRYING AND START LIVING, by Dale Carnegie, *Simon & Schuster,* $2.95

Books and Manuals

Soviet Arms & Soviet Power (Guillaume)	$ 3.50
Communism: Its Plans and Tactics	2.00
Nucleonics (simple atom explanation)	1.00
Cryptography	3.00
Magnetic Recording	5.00
Command Decision (Haines)	2.50
Eagle in the Sky (Mason)	3.00
Glory for Me (Kantor)	2.50
Guard of Honor (Cozzens)	3.50
No Bugles Tonight (Lancaster)	3.00
Scarlet Patch (Lancaster)	3.00
Eisenhower—Crusade in Europe	5.00
Marshall, King, Arnold—War Reports	7.50
Patton—War As I Knew It	4.00
Stilwell—Stilwell Papers	4.00
Churchill—Gathering Storm	6.00
Churchill—Their Finest Hour	6.00
Admiral Halsey's Story	4.00
McNair—Educator of an Army	2.00
Eleven Generals—Greene, Sheridan, Bradley, etc.	5.00
Washington, The Young (Freeman)—2 vols., set	15.00
Pershing, General John J. (Col. Palmer)	2.00
Company Commander (MacDonald)	3.00
Managing Men (for Noncoms)	2.00
National Security and the Gen. Staff (History, U. S. Staff)	5.00
Okinawa: The Last Battle	6.00
Carrier War (Jensen)	2.50
German Generals Talk (Hart)	4.00
Hitler and His Admirals	4.00
Manual for Courts-Martial, 1949, Air-Army	1.65
New Articles of War (Wiener)	1.00
Company Administration; paper	2.50
A.A.F. History in World War II	5.00
Annapolis (Puleston)	3.00
I Saw Fall of Philippines (Romulo)	3.00
Medal of Honor	4.50
Official History of A.A.D. (McCoy)	10.00
On Active Service (Stimson)	5.00
Roosevelt & Hopkins (Sherwood)	6.00
West Point (Baumer)	3.00
West Point (Crane & Kieley)	7.50
Ordeal by Fire (Pratt)	5.00
Abe Lincoln and the Fifth Column (Milton) paper .25; cloth	3.75
Gettysburg (Miers & Brown)	3.50
House Divided (Longstreet & Richmond)	5.75
Lee's Lieutenants, 3 vols. (Freeman)—each	7.00
Letters from Lee's Army (Blackford)	3.50
R. E. Lee (Freeman), 3 vols. set	25.00
Electrical Shop (Stone)	.40
Radio Operating (Stone)	.60
Radio Principles (Stone)	1.00
Take 'er Up Alone, Mister (Hibbits)	2.50